DOCUMENT RESUME

ED 023 584 72 SE 004 977

Curriculum and Teaching of Mathematics in the Higher Secondary Schools - An Analysis of Syllabuses.

National Council of Educational Research and Training, NIE Campus, New Delhi (India). Dept. of Curriculum and Evaluation.

Spons Agency-Office of Education (DHEW), Washington, D.C. Bureau of Research.

Report No-NIE-HEW-PROJ-009

Bureau No-BR-5-1402

Note-262p.

EDRS Price MF-$1.00 HC-$13.20

Descriptors-*Curriculum, Curriculum Development, *Elementary School Mathematics, *Instruction, Instructional Materials, Learning, *Mathematics, Objectives, *Secondary School Mathematics, Surveys, Textbooks

Identifiers-India

This curriculum project in general mathematics was planned in order to study syllabuses of the elementary and high school curriculum under the following broad categories: (1) objectives of education and mathematics, (2) arrangement of the content, the duration of the course and the achievement expected in each topic, and (3) objectives of education at the primary and the middle level. One of the reports is an analysis of 43 books in elementary mathematics that are in use in various states of the country. The purpose of this study was to obtain an analytical opinion from the teachers about the textbooks in actual use for teaching elementary mathematics. This information was classified according to general information, general organization of the textbooks, subject matter, style of writing, pictorial and graphic illustrations, and objectives. The second report is an analysis of a limited survey of 30 schools selected from four states of India. The purpose of this study was to determine the current teaching-learning practices followed by teachers and students in the study of elementary mathematics. A factual account of what was observed in classes by the investigators and reported by teachers and students during interviews is reported for the following areas: (1) motivation, (2) continuity, (3) teaching new concepts, (4) problem solving, (5) individual and group work, (6) homework, and (7) teaching aids. (RP)

PA-72

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

NIE-HEW PROJECT NO.009

CURRICULUM AND TEACHING OF MATHEMATICS IN THE HIGHER SECONDARY SCHOOLS

(An Analysis of Syllabuses)

ED023584

SE004 977

CURRICULUM AND TEACHING OF MATHEMATICS
IN THE
HIGHER SECONDARY SCHOOLS

AN ANALYSIS OF SYLIABUSES

MONOGRAM

NIE - HEW - 009
Department of Curriculum and Evaluation
(National Council of Educational Research & Training)
NIE Campus, Mehrauli Road, New Delhi-16.

Contents

SCHOOL STAGES 1

PART ONE: THE ELEMENTARY STAGE

I. Objectives of Education
II. Objectives of Teaching Mathematics 8
III. Arrangement of the Content 12
  A. Arithmetic 13
  B. Algebra 22
  C. Geometry 24

PART TWO: THE SECONDARY STAGE

I. Name and Status of the Subject 28
II. Examinations 30
III. Components of the Courses 35
IV. Objectives of Teaching the Subject 35
V. Observations 38
VI. Analysis of the Content 39
  A. Arithmetic 39
  B. Algebra 41
  C. Geometry 43
  D. Statistics 48
  E. Trigonometry 49
  F. Mensuration 50
  G. Demonstrations, Experiments and Practical Activities 51
  H. Suggestions to Teachers and Authors 54
  I. Equipment 59
  J. Books 61
Appendix

SCHOOL STAGES

A general description of the patterns as found in the different states will be useful before the position of mathematics is given below. It will also explain why it was thought necessary to undertake the analysis in two parts.

Two chief patterns are prevalent in the country with regard to the stages of education in the years at school.

(i) Three Stages:

(a) Primary: 5 years from class I to class V

(b) Middle/Junior High: 3 years from class VI to class VIII.

(c) Secondary: 2 or 3 years from class IX to class X/XI.

This pattern obtains in Assam, Bihar (for basic schools only), Delhi, Madhya Pradesh, Orissa, Punjab, Uttar Pradesh(which does not have higher secondary schools, but only high schools ending in class X and intermediate colleges ending in class XII) and West Bengal.

(ii) Two Stages:

(a) Elementary: 7 or 8 years from class I to class VII/VIII.

(b) Secondary: 3 or 4 years from class VIII/IX to class XI.

The seven-year elementary school pattern, followed by four years of secondary school, is followed in Andhra Pradesh, Bihar(for non-basic schools), Gujarat, Kerala(with a further sub-division of elementary into four-year lower and three-year upper), Maharashtra and Madras, Jammu and Kashmir has eight-year secondary schools.

(iii) Besides these two, there is a mixed pattern

(contd..)

in three States, presumably for the period of transition from the high school to the higher secondary pattern. These States are:

Madras:	Secondary course (classes VIII to X), and Higher Secondary course (class VIII to XI).
Punjab:	Matriculation course (classes IX and X), and Higher Secondary course(classes IX to XI).
West Bengal:	School Final course (classes IX and X), and Higher Secondary course(classes IX to XI).

PART ONE

THE ELEMENTARY STAGE

There is lack of uniformity also in the classification of the school stages. For example, in Assam, classes A,B,I, II and III constitute the primary stage and IV, V and VI, the middle. For purpose of comparison, therefore, the term Elementary Stage as used here will mean 'the first eight years of systematic study in school'.

The syllabuses have been studies under the following broad categories:

1. Objectives of education as found in them.

II. Objectives of mathematics as found in them.

III. Arrangement of the content, the duration of the course and the achievement expected in each topic.

I. OBJECTIVES OF EDUCATION AT THE PRIMARY AND THE MIDDLE LEVEL AS FOUND IN SYLLABUSES

A study of the general objectives of education which syllabuses consider worth mentioning should indicate the directions in which they expect the child to grow. These objectives as found in six syllabuses are given below:

(a). (i) To enable one to lead a healthy life; acquisition of minimum knowledge in health and hygience.

(ii) Ability to use the mother tongue and an understanding of the national language.

(iii) Understanding and appreciation of music, literature and art.

(iv) Development of tolerance, judgement and capacity to work as a successful member of the society.

(v) Respect for different religions and traditions of the world.

(b) (i) To develop love for truth and moral values.

(ii) To help the child to develop into a physically healthy and mentally alert individual.

(iii) To provide opportunities for the child to develop his whole personality and to enable him to understand and appreciate his environment in relation to his basic needs, like food, shelter and clothing.

(iv) To help the child to use in his daily life the skill and the knowledge that he acquires in the school and to express himself creatively and artistically.

(v) To develop in the child qualities of good citizenship to enable him to play his role effectively as a citizen of a democratic socialistic welfare state, to imbibe in him a patriotic fervour and to make him realize the basic unity of the country in its apparent diversity, and the oneness of the world.

(vi) To train the child to take an intelligent share in the life of the home, the community and the country.

(vii) To promote in the child the spirit of social service so that he imbibes in his life the principle of 'service above self.'

(viii) To provide facilities to the child to enable him to make his full contribution to the wealth of the nation by learning through purposeful, creative and productive activities.

(ix) To develop in the child a love for the cultural heritage of his pradesh and the country.

(c) (i) To provide rich and varied learning experiences for the pupils.

(ii) To enable children to make full use of every kind of printed matter.

(iii) To bring about the harmonious development of all the powers of the children.

(iv) To make the subject-matter relevant to the present and future needs of children rather than to satisfy merely academic and logical requirements.

(v) To bring about an inter-relation of subjects.

(d) (i) To provide for the full development of personality.

(ii) To prepare students for democratic citizenship.

(iii) To develop problem-solving skills.

(iv) To develop appreciation of natural phenomenon.

(v) To modify the behaviour patterns of the pupils so as to make the solution of day-to-day problems more effective and satisfying.

(e) (i) To make full use of the initiative of the children so that they do not remain passive.

(ii) To seek correlation of the subjects with the environment, social and physical.

(iii) To build up the health and character of the children.

(iv) To make children take part in recreational activities: folk songs, music, etc.

(f) (i) To prepare, train and equip the child to play his part successfully as a citizen.

Observations

1. Most syllabuses do not mention objectives at all. Those in Assam, Himachal Pradesh, Madras, Punjab, Kerala and Madhya Pradesh have mentioned a few. In some cases, the objectives have not been given clearly and prominently: they only occur in the introduction as principles which have been kept in view while suggesting teaching methods and activities.

2. Statements of objectives as given in the few syllabuses when taken together show that the following aspects have been recognized:

(i) Imparting fundamental knowledge, skills and abilities.

This includes reading, writing and arithmetic.

(ii) Making a good citizen.

This includes cooperation in the home and the community, recognizing the oneness of the world and sharing in the give and take with others.

(iii) Selecting a way of life.

This includes love for moral values and truth, faith in democracy and the socialistic pattern of society.

(iv) Developing character.

(v) Fostering right attitudes.

This includes tolerance, courtesy, honesty, patience and respect for other religions.

(vi) Use of leisure.

This includes worth-while activities which lead better understanding and appreciation of music, literature and art.

(vii) Value of manual work.

This includes the importance of craft work, farm activities and willingness to work with one's own hands.

(viii) Care of health.

This includes knowledge of health and hygiene, and a programme of physical education.

(ix) Knowledge of our cultural heritage.

This includes the celebration of important social and religious festivals.

(x) Future vocational needs.

3. The objectives as they have been detailed sometimes overlap. Major or ultimate objectives have not been clearly distinguished. They have been mixed up with objectives related to the development of character, attitudes, care of health, etc. which only help in the attainment of the major objectives.

4. The objectives, where mentioned, have laid emphasis on the utilization of experience of the day-to-day activities of the children and on guiding their interests and efforts for the ultimate achievement of the objectives.

5. No set of objectives found in the syllabuses is comprehensive enough to include all the important aspects mentioned above. The variety ranges from a single statement of objectives (as listed under f above) to a set of nine(as listed under b).

II. OBJECTIVES OF TEACHING MATHEMATICS AS FOUND IN SYLLABUSES

The objectives of teaching mathematics as found in six syallabuses are:

(a) (i) To develop the ability to solve common problems in arithmetic and geometry related with home and social life.

(ii) To develop interest for some vocation and to train in keeping correct account od different individual and group activities.

(iii) To train in clear, logical and critical thinking.

(iv) To develop problem-solving skills.

(v) To develop an attitude to work correctly.

(b) (i) To inculcate habits of an objective search for truth.

(ii) To develop accuracy, logical thinking and reasoning.

(iii) To inculcate the habit of working systematically.

(iv) To promote the power of concentration in the students.

(v) To help the students to understand the practical utility of the subject and enable them to apply the power of same in everyday life.

(vi) To create a sense of neatness and to promote the abstract thinking.

(c) (i) Skill in the four fundamental operations with numbers and litral numbers.

(ii) Knowledge of the primary concepts, facts, relations, operations, symbols etc., of mathematics.

(iii) Ability to make use of mathematical knowledge in the solution of the problems in the classroom and outside.

(iv) Ability for estimation of measurements and approximation of answers to problems.

(v) Ability to check answers.

(vi) Ability to represent verbal statements by diagrams and symbols.

(vii) Ability to interpret diagrams and symbols.

(viii) Ability for logical thinking i.e. to analyse a problem, to select relevant facts and reject others and to solve probler by using principles learnt.

(ix) Ability to find out the principles involved in a procedure.

(x) To develop habits of accuracy, precision, speed and neatness.

(d) (i) Knowledge of mathematical concepts, facts, terms, procedures, symbols and principles.

(ii) Ability to apply mathematical knowledge to problems in the classroom, in the world outside, and in the study of the sciences.

(iii) Ability to represent verbal statements by graphs, symbols and diagrams.

(iv) Ability to interpret graphical, symbolic and diagrammatic representations.

(v) Ability to analyse a problem, select the relevant facts, reject the irrelevant ones, solve it by the application of principles already learnt, and give a synthetic proof wherever necessary.

(vi) Ability to find out the principles involved in the steps of given procedures.

(vii) Ability to verify results wherever possible.

(viii) Capacity for estimation and approximation.

(ix) Habits of precision, accuracy, speed and neatness.

(x) Ability to appreciate the beauty, rhythm and symmetry of mathematics.

(e) (i) To give the pupil the ability to understand, grasp and tackle problems of arithmetic connected with everyday lfe with accuracy and confidence.

(ii) To develop the intelligence of the pupil and providing training in abstraction, judgement and reasoning.

(iii) To impart knowledge and ability to continue the study of the subject in higher classes.

(f) (i) To utilize mathematical processes in solving everyday problems.

(ii) Ability to solve everyday problems involving accounts and measurement occurring in everyday activities or vocations.

(iii) Ability to think clearly and logically.

(iv) Ability to check the results.

Observations

1. Most syllabuses do not specifically mention any objectives for the teaching of mathematics. Those in Punjab, Himachal Pradesh, Bihar, Kerala, Madhya Pradesh

and Assam have only mentioned the objectives recorded above.

2. The objectives recorded above show that consideration has been given to the following aspects:

(i) Computational skills and abilities

This includes knowledge of mathematical concepts, facts and principles

(ii) Utility of mathematics

This includes ability to apply mathematical knowledge to solve everyday problems.

(iii) Work habits e.g., neatness, accuracy, checking results

(iv) Problem-solving skills

This includes the ability to analyse a problem, select the relevant facts and reject the irrelevant ones, etc.

3. This shows that the syllabuses no longer stress that view which limits the objectives of mathematics teaching to the learning of basic computational skills. The importance of making children understand how mathematical skills function in daily life has been clearly emphasized.

4. The objectives indicated in the syllabuses can be grouped under two categories: (i) those related to the mathematical aspect and (ii) those related to the social aspect.

(i) Mathematical Aspect

(a) Ability to perform necessary computations.

(b) Accuracy, precision, speed, neatness, etc.

(c) Ability to represent verbal statements by diagrams and symbols.

(d) Ability for logical thinking, i.e. to analyse a problem.

(e) Ability to estimate measurements and to conceive approximation of answers.

(ii) Social Aspect

(a) Ability to solve common problems related with the home and social life.

(b) To develop interest in some vocation

III. ARRANGEMENT OF THE CONTENT

1. In listing the content, all syllabuses have followed the logical sequence of different mathematical processes.

2. Each process has been spread over more than one year, occurring in successive years with higher and higher levels of difficulty.

3. The content has been arranged under topics, further divided into sub-topics. Basic concepts underlying the topics or sub-topics have nowhere been indicated.

4. Most syllabuses do not clearly define the scope of a topic. The sequential listing of desirable understandings to be included under each topic is left to textbook writers and teachers. Neither has the connection and continuity of the various processes been brought out.

5. The material in the syllabuses has been arranged classwise, and the levels of achievement have been assumed to be uniform for all pupils in the same class.

6. All syllabuses lay emphasis on 'revision', but in most of them it is indicated by way of a statement, 'Revision of work done in previous class', without suggesting any specific revision of each topic or any re-teaching of old concepts necessary for learning new ones.

7. In most syllabuses the suggestions for teaching and learning activities are given in general for each stage, and the syllabus for each class gives only an

outline of topics to be taught. In a few, however, e.g., in Madras and Kerala, practical activities and teaching suggestions have been given side by side with each topic for each class.

An attempt is made below to ascertain the most outstaning trends and practices with regard to the teaching of the important topics common to all mathematics syllabuses.

A-ARITHMETIC

Number and Notation

(i) All syllabuses introduce number and notation in the first year and spread them over four years.

(ii) In so far as the maximum achievement is concerned all except Madhya Pradesh, have included 'numeration and notation up to crore' and expect pupils to be able to perform basic operations with these numbers.

(iii) The achievement expected at the end of each year is:

1st year	Numbers up to 100
2nd year	Numbers up to 1,000 (Exceptions are Delhi and Uttar Pradesh, where it is upto 9,000).
3rd year	In Assam, Andhra Pradesh, Gujarat, Maharashtra, Madras, Mysore and Kerala: numbers up to ten-thousands. In Bihar, West Bengal and Orissa: numbers up to one lakh. In Delhi, Punjab and Himachal Pradesh: numbers up to ten lakhs. In Rajasthan and Uttar Pradesh: numbers up to one crore.

4th year — In Andhra Pradesh, Madhya Pradesh, Mysore and Madras: numbers up to ten lakhs.

In Assam, Bihar, Delhi, Gujarat, Maharashtra and Kerala: numbers up to one crore.

In West Bengal, Bihar and Rajasthan: reading and writing of all numbers.

Orissa, Punjab and Rajasthan do not mention anything.

5th year — Only Andhra Pradesh, and Madras include 'relation of a crore to a lakh.'

(iv) All syllabuses emphasize counting in the Indian system, i.e., crore, lakh, etc.

(v) All lay emphasis upon the reading, writing and under-standing of numbers.

(vi) Most syllabuses do not clearly indicate the scope of the content. Nor are the concepts underlying the understanding of the numbers clearly indicated or grade. As for example, matching or one-to-one correspondence and grouping which is basic to the understanding of the concept of counting, is not indicated in any syllabus.

(vii) References to underlying concepts are found only in the Kerala and Delhi syllabuses. The Kerala syllabus emphasizes grouping, arraning in patterns and number rhymes. It also introduces the idea of 'even' and 'odd' numbers in the first year. The Delhi syllabus mentions the concept of 'order'.

(viii) 'Zero' is an important number and a difficult concept to visualize. Only Madras and Kerala have mentioned this.

(xi) The counting, reading and writing of numbers more than 10 pre-supposes a knowledges of units, tens and hundreds, etc., but most syllabuses do not lay any emphasis upon the place-value concept.

(x) Counting in larger groups is a prerequisite to the addition and multiplication of numbers. All syllabuses introduce in the first year counting by 2's, 3's, 4's, 5's and 10's up to 100.

Addition and Subtraction

(i) Addition and subtraction concepts are introduced everywhere in the first year and are spread over three years, during which different skills and abilities connected with addition and subtraction are taught. In the fourth and fifth years the skills learnt earlier are used with bigger numbers and these processes are applied to measures also.

(ii) The achievement level expected is:

1st year:	Sum not exceeding 100
2nd year:	Sum not exceeding 1000
3rd year:	Sum not exceeding 4 or 5 digit numbers

Terms like 'oral addition', 'simple addition', 'easy addition comibations', 'difficult addition', have been frequently used to indicate the achievement level in different years, but the exact scope of these terms is not indicated.

(iii) On the whole, very few stages are visualized in the gradation of addition or subtraction from year to year. The stages for addition mentioned in the syllabuses are:

(a) Oral addition: Sum not exceeding 10 or 20.

(b) Addition: Sum not exceeding 100

(c) Addition of 3 and 4 digit numbers

This classification does not take into consideration all the skills and abilities a child needs in order to master the process of addition. Classification of addition sums as those involving carrying over and those not involving carrying over has been indicated only in Madras, Kerala, Mysore and Punjab.

(iv) The 'language of mathematics' does not find mention in every syallabus. Only a few States, West Bengal, Delhi, Kerala and Rajasthan, have included the symbols +, =, and - .

(v) 'Horizontal addition' or 'adding in rows' involves a skill different from that necessary for 'addition in columns'. Only West Bengal has suggested addition in horizontal columns in the second year.

(vi) Subtraction is usually mentioned concurrently with addition, e.g. 'simple addition and subtraction up to 90 without carrying over; 'difficult addition and subtraction', 'addition and subtraction of numbers up to three digits'. It is not clearly indicated what skills are necessary for subtraction or what type of sums are to be included. The concept of 'borrowing' or ' no borrowing' is hardly mentioned.

Multiplication

(i) Most syllabuses spread multiplication over three years, though Andhra Pradesh, West Bengal, Bihar, Kerala, Madras and Punjab do not start it in the first year.

(ii) The achievement expected each year is:

1st Year:	Preparation and memorization of multiplication tables up to 10x10.
2nd year:	Preparation and memorization of multiplication tables up to 16x10 or 20x10.
3rd year:	In some states multiplication tables continue, while in others there is no clear indication about achievement expected.
Rajasthan:	Multiplication by a number up to three digits.
Uttar Pradesh:	Harder multiplication.
Mysore:	Muliplication of a two-digit number by a two-digit number.
Bihar:	Long multiplication, the result not exceeding six digits.
4th Year:	Two or three syllabuses include multiplication tables of fractions, ½,¼,¾,etc., along with compund multiplication.

(iii) It follows that emphasis is laid on the preparation and memorization of tables. The skills and abilities, a child is expected to master in a particular year, are not indicated anywhere.

(iv) Not many details of the content are provided anywhere.

(v) A few syllabuses include counting by 2's, 3's, 4's, 5's and 10's up to 100, which brings out the relationship between the process of addition and multiplication. Only the Kerala syllabus specifically mentions that multiplication should be introduced as 'repeated addition'.

(vi) Some syllabuses prescribe multiplication tables up to 16x10, whereas others up to 20x10.

Division

(i) Division is introduced in the second year in most syllabuses and is continued during the next two years. In all, the duration allowed for the mastery of the division process is three years.

(ii) The achievement expected is:

2nd year: The divisor not exceeding two digits is the maximum expected.

3rd year: The emphasis is on long division. Most syllabuses limit divisors to 2 or 3 digit numbers.

4th year: At the end of this year pupils are expected to know all skills involved in division. Phrases like 'long division', 'compound division' have been used to indicate the achievement.

(iii) [illegible] gradation of content is not clear in any syllabus; nor is there any mention of the necessity of teaching the basic facts in division.

Fractions and Decimals

(i) All syllabuses, excepting those in Andhra Pradesh, Assam, Madras and Uttar Pradesh, introduce fractions in the third year, the others starting some preliminary notions in the second. The duration is four years, i.e. till the end of the sixth year, in most syllabuses. In a few states, like Andhra Pradesh, Assam, West Bengal and Madras, fractions and decimals continue till the eight year.

(ii) The achievement expected during each year is:

3rd year: Idea of fractions and their use (fractions specifically given are ½, ¼, ¾)

Multiplication tables of ½, ¾, 1¼, 1½, 2½ etc. up to 20.

4th year: Simple fractions - addition and subtraction, Andhra Pradesh, Delhi, Himachal Pradesh and Madras: Idea and use of decimals.

Assam and Uttar Pradesh: L.C.M., H.C.F.
Andhra Pradesh, West Bengal, Madras and Mysore: Multiplication of fractions by whole numbers.

5th year: Addition, subtraction, multiplication and division of fractions.

Punjab, Mysore, Maharashtra, Gujarat, Himachal Pradesh and Delhi: L.C.M., H.C.F.

6th year: Compound fractions, combined operations with fractions, reduction, simplification.

(iii) The break-up of the content is not very explicit, for in most cases the achievement expected is not defined. For example, the Rajasthan syllabus gives the following stages:

(a) Notion of fractions ¼, ½, ¾.

(b) Simplification by using brackets, excluding compound and mixed fractions. Four operations with fractions.

(c) Multiplication tables of ¼, ½, ¾, 1¼, 1½ L.C.M., H.C.F.

(d) Converting two-place decimals into fractions.

The Delhi syllabus gives the following stages:

(a) Idea of fractions ¼, ½, ¾, and their practical value.

(b) G.C.M. and L.C.M. and easy problems relating to these.

(c) Vulgar fractions: reduction, comparison, addition, subtraction, multiplication and division.

(d) Conversion into decimals.

Except in one or two cases, no syllabus attempts to split up the content for fundamental operations with fraction.

(iv) Fractions have been associated with the learning of money, weights and the preparation and memorization of multiplication tables of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $1\frac{1}{4}$, $1\frac{1}{2}$ have been emphasized.

(v) Only Madras and Andhra Pradesh indicate that fractions with unusually large denominators should be avoided.

(vi) There is no uniformity in the year of introducing decimal fractions.

3rd year: West Bengal

4th year: Andhra Pradesh, Delhi, Himachal Pradesh and Kerala.

5th year: Assam, Mysore, Punjab and Rajasthan

6th year: Gujarat, Maharashtra and Uttar Pradesh.

Percentage and its Application

(i) Percentage is introduced in the sixth year in most states. Three states, however, introduce it in the fifth year and one, in the seventh.

(ii) 'Profit and loss' is usually introduced in the fifth year, and some states introduce it without having previously taught percentage. 'Profit and loss' is classified as (a)'Profit and loss: simple questions' (b)'Profit and loss: harder examples.'

(iii) 'Simple interest' is introduced in the fifth year in some cases and in the sixth year in others. Most syllabuses spread it over three years. Except for Madras and Kerala, it is split up into two stages: (a) 'Simple Interest easy questions' (b) 'Simple Interest: difficult questions or advanced work'. The stages worked out in Madras and Kerala are more detailed and indicate the type of skills and abilities the child is expected to acquire.

(iv) 'Compound interest' is included in the eight year in two syllabuses only but its scope is not clearly defined.

Money and Measures

With the introduction of Decimal Coinage and Metric System of Weights and Measures, the need to revise the syllabuses is evident, though most syllabuses still mention old weights and measures and emphasize conversion of old measures and coins into new.

Average

Average is included in the fifth or the sixth year with few indications about the scope of the topic.

Ratio and Proportion

Ratio and Proportion occurs in the seventh year in most syllabuses. Maharashtra and Gujarat include 'simple examples not including fractions' in the fourth year. The achievement level expected cannot be assessed as the scope is not indicated. Some divide Proportion into direct and inverse, others into simple and compound. Only a few indicate sub-topics, like proportional division, partnership, problems on time and work, etc. Only the Madras syllabus gives a comprehensive list of sub-topics to be included in each year.

Area and Volume

(i) Area is introduced in the

4th year: in Andhra Pradesh, Delhi, Himachal Pradesh, Madras and Punjab.

5th year: in Bihar, Mysore, Gujarat and Maharashtra.

6th year: in West Bengal

7th year: in Assam, Orissa and Uttar Pradesh

8th year: in Rajasthan

(ii) The achievement expected is: (a) calculation of area of rectangles and squares, and its applications in area of fields, walls, cost of fencing, paving with stones, etc.,(b) area of triangles and its applications, and (c) area of circles.

Punjab, Madhya Pradesh, Orissa, West Bengal and Himachal Pradesh do not include the area of circles. Only two or three states include plane figures other than triangles, rectangles and squares.

(iii) The year-wise study of achievement indicated that there is no uniformity.

4th year:	Andhra Pradesh, Delhi, Himachal Pradesh, Madras and Punjab	Area of squares and rectangles
5th year:	Andhra Pradesh, Assam, Bihar, Delhi, Gujarat and Maharashtra	Applications of the area of rectangles and squares, area of four walls, paths, fields, etc.
	Assam and Himachal Pradesh	Area of triangles
	Gujarat, Maharashtra, Punjab and Madhya Pradesh	Drawing to scale
	Himachal Pradesh	Area of parallelograms and quadrilaterals.
6th year:	West Bengal, Kerala and Madras	Area of rectangles and suqares (introduction)
	Bihar, Delhi and Kerala	Area of fields; four walls, paths, etc.
	Bihar	Area of triangles
	Bihar and Kerala	Area of circles
	Bihar	Volume (introduction) of rectangular solids

7th year:	Andhra Pradesh, Madras, Punjab, Uttar Pradesh and Orissa.	Area of four walls, paths, fields etc.
	West Bengal and Kerala, West Bengal, Kerala, Madras and Mysore.	Area of triangles Volume (introduction) of rectangular solids.
	Gujarat, Maharashtra, Kerala, Mysore and Uttar Pradesh	Area of circles
	Mysore	Volume of cylinders
8th year:	Andhra/Pradesh	Area of triangles, Area of circles
	Andhra Pradesh and Uttar Pradesh	Volume of rectangular solids.
	West Bengal, Madhya Pradesh, and Mysore.	Area of rectangles, squares (difficult examples)
	Himachal Pradesh, Orissa and Rajasthan	Area of four walls, paths, etc. (difficult examples)
	Madhya Pradesh and Mysore Rajasthan	Area of parallelograms; trapeziums Area of triangles

(iv) Volume of rectangular solids is included in the syllabuses in Bihar, West Bengal, Kerala, Madras, Mysore, Andhra Pradesh and Uttar Pradesh. Only the Mysore syllabus includes volume of cylinders.

B. Algebra

1. There is no uniformity in the year in which algebra is introduced in the states:

6th year:	Himachal Pradesh, Punjab, Rajasthan and Uttar Pradesh.

7th year: Andhra Pradesh, Assam, West Bengal, Delhi, Kerala, Madhya Pradesh and Madras.

8th year: Bihar, Gujarat, Maharashtra, Mysore and Orissa.

2. The achievement level expected at the end of the eight year is not the same in all the states. The following is the core content:

Use of symbols, four fundamental rules, brackets, substitution, simple equations and problems, formulae $(a+b)^2$, $(a-b)^2$, $(a-b)(a+b)$.

The following are significant additions to this core:-

States	Additions
Assam	Cubic formulae, factorization, H.C.F. and L.C.M.
West Bengal	Cubic Formulae, Factorization, H.C.F. and L.C.M.
Delhi	Easy simultaneous equations, solving equations by graph.
Madras	Geometrical proofs of identities.
Mysore	Fractions
Uttar Pradesh	Simultaneous equations and graphs.

3. All syllabuses begin algebra with the fundamental operations.

4. Most syllabuses treat algebra as distinct from arithmetic and geometry, only a few suggesting its introduction as generalized arithmetic. No syllabus suggests any correlation between algebra and geometry. Only the Madras syllabus mentions that geometrical proofs of indentities should be given, though this hardly means that the use of geometrical applications has been stressed.

5. 'Graph' as a method of solving equations has

been included included in the syllabus in West Bengal, Delhi, Madhya Pradesh, and Uttar Pradesh. Only the Delhi syllabus has mentioned graphs of temperature, etc. and has spread them over two years, the seventh and the eighth.

C.GEOMETRY

1. There is no uniformity in the year in which a systematic teaching of geometrical concepts starts. Some syllabuses have postponed it till as late as the sixth year, though some informal work with geometrical figures is expected in early years. This informal work is mostly connected with the use of simple instruments, drawing lines, parallel lines, circles and rectangular figures, arising out of everyday activities, such as measuring the length, breadth, height and surface of things. Also, pupils are expected to get some preliminary notions about a few plane figures and solids as part of simple mensuration work.

2. The year when the syllabuses introduce the systematic teaching of geometry is as follows:

1st year:	Bihar, Delhi, Himachal Pradesh and Rajasthan.
2nd year:	Uttar Pradesh
3rd year:	Mysore
4th year:	Kerala, Maharashtra and Gujarat
5th year:	West Bengal, Madhya Pradesh and Madras
6th year:	Assam, Orissa, Punjab and Andhra Pradesh.

3. The syllabuses indicate different approaches to the introduction of geometric concepts. The Delhi syllabus emphasizes recognition and handling of simple solids, viz. cubes, cylinders and spheres to begin with, whereas others follow the traditional way, i.e. introducing in

7 sequence, point, lines, angles, etc. Himachal Pradesh emphasizes the recognition of both the plane figures and solids in the early years.

4. All states lay stress on practical work and experimental verification of the geometrical properties of figures and solids, Formal proofs to geometrical propositions are not included. A few states emphasize both measuring and estimation of length, breadth, etc.

5. There is no systematic mention of the understandings and skills associated with particular geometric concepts. For example, for straight lines and curved lines the stages worked out in a few syllabuses are as follows:

Bihar	Recognition of straight and curved lines	Ist year
	Drawing straight lines	4th year
Delhi	Idea of straight and curved lines. Measuring straight lines in inches and cms.	4th year
Himachal Pradesh	Recognition of straight lines	1st year
	Measurement of lines with a metre rod	2nd year
Kerala	Straight and curved lines Training to measure in cms and mm. Construction of straight lines of given lengths.	5th year
Mysore	Lines - straight and curved	3rd year
	Drawing straight lines of given lengths and comparing lengths	4th year
Rajasthan	Recognition of straight and curved lines	1st year
	Drawing straight and curved lines	3rd year
	Measurement and construction of straight lines	6th year

There is thus no systematic break-up of the understandings and skills that are necessary for the mastery of the facts about the straight lines. There is no uniformity either in the year in which these are to be introduced. The same is the case with other geometric concepts like angles and parallel lines. No comparative assessment of the achievement expected for each year is, therefore, possible.

6. A few syllabuses lay emphasis upon observing the geometric properties in the things around; others do not give any suggestions on the method of introducing these concepts.

7. The achievement during the eight year which is practically the same in all states includes:

(i) Point; straight and curved lines; types of angles; parallel lines; perpendicular lines.

(ii) Common properties of plane figures, triangles, type of triangles, quadrilaterals (squares, rectangles, parallelgrams, rhombuses); circles (idea of centre, circumference, diameter, radius, are); polygons -pentagon and hexagon.

(iii) Verfication of the sum of the angles of a triangle.

(iv) Idea of simple solids - cones, cylinders, spheres.

(v) Similarity and congruency of triangles.

(vi) Area of triangles, trapezoids and circles.

(vii) Experimental verfication of proposition of angles; angles and sides of a triangle; parallel lines; congruency of triangles; parallelograms.

(viii) Construction on angles, equal angles, bisection of angles; bisection of a straight line, dividing a line into a number of parts; triangles, quadrilaterals, parallelograms, rectangles, squares; drawing a circle about and inside a plane figure like square, hexagon.

PART TWO

THE SECONDARY STAGE

I.NAME AND STATUS OF THE SUBJECT

1. At the secondary stage, most states teach mathematics at more than one level, but one course is everywhere compulsory for almost all students. This course is being analysed in the following pages. Different names have been given to it:

Elementary mathematics: Rajasthan, Delhi, Gujarat, Maharashtra, Andhra Pradesh, Bihar,West Bengal, Punjab.

General mathematics: Madras, Kerala, Assam, Mysore.

Compulsory mathematics: Orissa

Mathematics: Uttar Pradesh, Madhya Pradesh, Jammu and Kashmir.

2. As has been said, this course is compulsory in all states, but there are a few restrictions in Delhi, Madras, Gujarat, Bihar and Maharashtra.

(i) In Delhi, Elementary Mathematics is compulsory for candidates who do not take Mathematics or lower Mathematics and Geometrical Drawing or Arithmetic and Domestic Science (in case of girls only).

(ii) In Madras, if a student offers composite Mathematics as one of the subjects, he is not required to study General Mathematics separately.

(iii) In the case of Maharashtra and Gujarat, elementary mathematics is in the compulsory group of subjects but an option is given to the students to select any two of the three subjects, Social, Studies, General Science and Elementary Mathematics, Further, Elementary Mathematics can be replaced by algebra-geometry in group III and by book-keeping and accounts in group IV.

(iv) In case of Bihar students offering optional groups, Natural Sciences, Agriculture and Elementary Engineering have to offer Elementary Mathematics. Others have to take up Everyday Science.

3. General mathematics, the name that is given here to all types listed under 1 above, has an independent status in all states except in Madhya Pradesh and Andhra Pradesh.

(i) In Madhya Pradesh, it is combined with general science and the two make one paper.

(ii) In Andhra Pradesh elementary mathematics is combined with either Social Studies or General Science. Students offering the Science, Technical, Agriculture, or Fine Arts group of electives, are required to take social studies including mathematics, and those offering the Humanities Commerce or Fine Arts group, general science including mathematics. Students offering the Home Science group have the option of studying any of the two combinations.

4. There is no uniformity with regard to the duration of the course or the classes in which it is taught. The details are given below:-

States	Classes	Duration
Delhi	IX	1 year
Rjasthan, Uttar Pradesh, Bihar, Jammu and Kashmir Punjab, West Bengal	IX, X	2 years

States	Classes	Duration
Mysore, Kerala	VIII,IX,X	3 years
Madhya Pradesh	IX,X,XI	3 years
Madras,Gujarat, Maharashtra, Assam,Orissa	VIII,IX,X,XI	4 years
Andhra Pradesh	IX,X,XI,XII	4 years

5. The time allotted to general mathematics is mentioned in the syllabuses of only five states - Andhra Pradesh,Mysore,Madras,Kerala and Assam.

States	Periods per week
Andhra Pradesh	6,for both mathematics and general Science/social studies.
Mysore	4 or 4½
Kerala,Madras	5
Assam	5 in class VIII 2 in classes IX,X and XI

II.EXAMINATIONS

1. For the assessment of students, the following practices are observed:

(i) There is an external examination conducted by a Board or University in Uttar Pradesh, Delhi, Orissa, Gujarat, Maharashtra, Andhra Pradesh, Mysore, Kerala and Jammu and Kashmir.

(ii) There is an external examination by a Board/ University and aslo internal assessment in Punjab,Rajasthan and Bihar.

(iii) There is only internal assessment by the head of the school in Madhya Pradesh and West Bengal.

The syllabuses in Madras and Assam do not mention anything about the examination.

2. The total marks allotted to general mathematics

at the examination are:

Marks	States
200	Bihar (100 in class X and 100 in class XI) and Jammu and Kashmir.
100	Orissa, Gujarat, Maharashtra, Andhra Pradesh, Mysore, Kerala, West Bengal, Uttar Pradesh and Punjab.
75	Delhi and Madhya Pradesh
50	Rajasthan

The distribution of marks for the external examination and internal assessment is as given below:

	External	Internal	Total
Punjab	75	25	100
Bihar	80	20	100
Rajasthan	45	5	50

3. There is only one paper at the final examination in Punjab, Delhi, Rajasthan, Bihar (both in class X and in class XI), Madhya Pradesh, Orissa, Gujarat, Maharashtra, Andhra Pradesh and Mysore; and two in Uttar Pradesh and Kerala, each paper being of 50 marks. In Jammu and Kashmir there are 2 papers of 100 marks each.

4. A further break-up of marks as given in the following syllabuses is as below:

Punjab	Arithmetic	20
	Algebra	25
	Geometry	30
	Assessment	25
Orissa:	Arithmetic	25
	Algebra	30
	Geometry	30
	Mensuration	15

Bihar: (in class X)	Arithmetic	15
	Algebra	15
	Plane Geometry	30
	Plane Trigonometry	15
	Assessment	20
(in class XI)	Arithmetic	20
	Algebra	20
	Geometry	10
	Trigonometry	20
	Assessment	20

5. The examination is held at the end of class IX in Delhi; class X in Uttar Pradesh, Punjab, Rajasthan, Mysore, Kerala, West Bengal and Jammu and Kashmir; class XI in Madhya Pradesh, Orissa, Gujarat and Maharashtra, and class XII in Andhra Pradesh. In Bihar there is one paper at the end of class X and one at the end of class XI.

6. A few states offer some concessions to students for purpose of qualifying at the examination in general mathematics.

(i) In Punjab, for a student who fails in general (i.e. elementary) mathematics, a supplementary examination is held in August which he must pass.

(ii) In Delhi, if a student fails in general (i.e. elementary) mathematics at the examination held at the end of class IX, he is promoted to class X provided he is otherwise eligible for promotion, but he has to appear in general mathematics at the end of class X. In case he does not pass even then, he is not promoted to class XI till he passes.

(iii) In West Bengal a student who fails in general (i.e. elementary) mathematics at the end of class X is allowed promotion to class XI but has to take this examination again at the next annual examination or earlier, according to his convenience.

7. The minimum pass marks in general mathematics as found are:

33% in Uttar Pradesh, Punjab and Delhi
30% in Andhra Pradesh and West Bengal
35% in Mysore
20% in Rajasthan.

In Madhya Pradesh a student must obtain at least 50 marks in both general science and general mathematics.

Other syllabuses do not mention minimum pass marks.

8. As compared to other core(i.e.compulsory) subjects, general mathematics is given equal weightage (100 marks) in Uttar Pradesh, Gujarat, Mysore, Kerala and West Bengal. The number of such subjects is not, however, the same in all these states.

State	Core subjects other than General Mathematics	Marks for each
Uttar Pradesh	Two languages	100
Gujarat and Maharashtra	Two languages, Social studies and general science.	100
Mysore and Kerala	Two languages, Social studies and general science.	100
West Bengal	One language, crafts, social studies and general science	100

The weightage is not the same as for other core subjects in Punjab, Delhi, Rajasthan, Bihar, Madhya Pradesh, Orissa, Andhra Pradesh and Jammu and Kashmir.

State	Weightage in marks indicated in brackets.
Punjab	Two languages (150,75); social studies(150); general science(150); mathematics(75); craftwork(50)
Delhi	English(200); Hindi(75); elementary mathematics(75)
Rajasthan	Three languages(50 each); general science(50); social studies(50); elementary mathematics(50)
Bihar	Two languages (200 each); social studies (100); elementary mathematics(100) or everyday science (100)
Orissa	Three languages (100,200,100); mathematics (100) social studies(100) general science(100)
Andhra Pradesh	Three languages (200,100,200); social studies including mathematics (200); general science including mathematics(200)
Jammu and Kashmir	Language(200); mathematics(200); history and geography(150)

In Madhya Pradesh there are six core subjects- three languages, social studies, general science(including mathematics) and a craft. Marks are not given in the syllabus.

III.Components of the Courses

The subject areas covered in the general mathematics courses are:

(i)Arithmetic,Algebra and Geometry	All States
(ii)Statistics	Madhya Pradesh,Madras and Assam.
(iii)Mensuration	Madhya Pradesh,Gujarat, Maharashtra,Bihar, Andhra Pradesh,Assam, Orissa,West Bengal, Punjab and Mysore.
(iv) Trigonometry	Madras,Bihar and Jammu and Kashmir.

Patterns of Organization

In all states the syllabus is organized in terms of subject areas. The content in each area is arranged classwise in Rajasthan, Madras, Andhra Pradesh, Kerala, Assam, West Bengal and Mysore. In other states, i.e. Uttar Pradesh, Madhya Pradesh, Gujarat, Maharashtra, Bihar, Punjab and Jammu and Kashmir, the total content is given, the split-up being left to the teacher or the author. The syllabuses mention the topics under each subject area but do not give any indication of the level of difficulty at which each topic is expected to be treated. Madras, Gujarat, Maharashtra and Kerala mention a few sub-topics under each topic.

IV OBJECTIVES OF TEACHING THE SUBJECT

Not all states explicitly mention the objectives of teaching the subject. The syllabuses in Uttar Pradesh, Madhya Pradesh, Delhi, Punjab, Bihar, Orissa, Maharashtra, Gujarat, Assam and Jammu and Kashmir do not mention the objectives clearly. Some statements are found in the syllabuses of the followingstates:

West Bengal

To revise the work done in the earlier classes and reorient it to the use of Mathematics in daily life.

Approach:

1. The teacher should define the various terms used in the course content and show their practical utility.
2. The teacher should not burden the students with too many mathematical details, methods and problems.

Andhra Pradesh

To develop skill in simple practical applications.

Approach:

1. Stress should be laid more on the method of treatment than on the matter taught.
2. The problems should be simple, direct and related to life without involving multiplicity of processes.
3. Complicated inverse problems should be avoided.

Rajasthan

1. To help each student to attain a level of mathematical competence which he needs to deal successfully with problems of everyday life in home and in business.
2. To provide a rich background for understanding other subjects where required.
3. To enable the student to understand the basic relationships of algebra, arithmetic and geometry.

4. To make mathematics a meaningful rather than a mechanical process.

Approach:

The examinations should emphasize-natural,direct questions pertaining to everyday life.

Mysore

1. To develop abilities and skills in handling life-situations involving mathematical concepts.
2. To improve speed, accuracy and neatness in mathematical work.
3. To develop in the students the capacity to analyse and solve problems.

Approach:

1. By concrete situations and pupils' experience.
2By the method of 'learning by doing.'
3. By providing adequately grades drill, suitable problems and tests.
4. By reviews and revisions at suitable stages.
5. Through easy problems and common situations.
6. By practical work before topic study.
7. By simple problems done at appropriate stages.

Kerala

1. Knowledge of mathematical concepts, facts, terms, procedures, symbols and principles.
2. Ability to apply mathematical knowledge to problems in the classroom, in the world outside and in the study of the sciences.
3. Ability to represent verbal statements by graphs, symbols, and diagrams.

4. Ability to interpret graphical, symbolic and diagrammatic representations.
5. Ability to analyse a problem, select the relevant facts, reject the irrelevant ones, solve the problem applying principles already learnt and give the synthetic proof wherevery necessary.
6. Ability to find out the principles involved in the steps of given procedures.
7. Ability to verify results wherever possible.
8. Capacity for estimation and approximation
9. Habits of precision,accuracy speed and neatness.
10. Ability to appreciate the beauty,rhythm and symmetry of mathematics.

V OBSERVATIONS

1. Even the five states which mention the objectives of teaching mathematics do not follow the same pattern, the variety extending from a single statement, as in West Bengal and Andhra Pradesh, to as many as ten, as in Kerala. The single statements only lay down the point of view, whereas in the other cases a few specific abilities, skills and habits are mentioned.
2. All these five states lay stress on the utility of mathematics in daily life.
3. The following purposes of teaching general mathematics appear to be most common:
   (i) To develop understanding of those mathematical concepts, facts, terms, procedures, symbols, relationships and principles which are needed to solve everyday problems.

(ii) To develop ability to solve problems in life and in other subjects.

(iii)To develop such qualities as

(a) working with speed, precision, accuracy and neatness

(b) estimation and approximation

(c) checking results.

4. Only the Kerala syllabus speaks of mathematics as a symbolic language, and the Rajasthan syllabus of the basic unity of arithmetic, algebra and geometry.

5. The general emphasis is on the practical applications of mathematics. All these states also suggest that the teaching should be restricted to simple, easy and real problems, and, as far as possible, to concrete situations. Learning by doing is emphasized.

6. One significant fact is that no state mentions the development of computational ability as one of the aims, although it is implicit in some statements. There is a clear shift in emphasis; for the mastery of computational skills as tools is no longer regarded as the chief function of mathematics teaching; the understanding and performance of number operations with intelligence and insight have gained more importance.

VI. ANALYSIS OF THE CONTENT

Arithmetic

1. Althought in most states the syllabus is arranged according to topics, there is a great variation in the number of topics included. It varies from eight topics (in Mysore) to 18 (in Delhi). The load in terms of topics in each state is given --------

below:-

State	No.of topics in the syllabus
Mysore	8
Rajasthan, Punjab, Maharashtra, West Bengal	11
Andhra Pradesh, Bihar Gujarat, Jammu & Kashmir	12
Uttar Pradesh, Assam	13
Kerala, Madras	15
Orissa, Madhya Pradesh	16
Delhi	18

2. The range of the topics is given below in the order of their frequency:-

Simple and Compound Interest	16
Percentage	14
Profit and Loss	13
Vulgar and Decimal Fractions	12
Areas and Volumes	12
Discount	12
Ratio and Proportion	11
Square-root	11
Average	10
Foreign Exchange	9
Banking, Insurance, Credit Bill	9
Stocks and Shares	8
Approximations	8
Time and Work	7
Metric System	7
Partnership	6
Unitary method	5
Taxes	5
Proportional division	4

Time and Distance	4
Factors and Prime Numbers	3
G.C.M. & L.C.M.	3
Numerations, Notation Four Fundamental Rules	2
Payment by Instalment	2
Graphs	2
Practice	2
Calendar	1

3. The topic, 'Numeration,notation and four fundamental rules', is included only in Delhi and Jammu and Kashmir syllabuses and 'Calendar' in the Punjab syllabus only.

4. 'Practice' is included only in West Bengal and Delhi. In Delhi, however, this is to be removed in 1966.

5. The Madras syllabus has a few topics which usually do not fall under the category of those listed above. These are 'Mean value errors', 'Circles', 'Statistics' and 'Englarging and reducing plane figures'.

6. The syllabuses do not indicate the types of problems or the level of difficulty with regard to the topics; it is thus not possible to compare the scope of each topic in different states.

Algebra

States	No.of topics in the syllabus
Andhra Pradesh	3
Assam	9
Bihar	13
Delhi	7
Gujarat	6
Kerala	11
Maharashtra	8

Madhya Pradesh	6
Mysore	4
Orissa	12
Punjab	6
Rajasthan	5
Uttar Pradesh	9
Madras	7
West Bengal	12
Jammu and Kashmir	11

2. The range of topics in the order of their frequency is as follows:

Simple equation and problems with one variable	15
Factors	14
Simple equation and problems with more than one variable	13
Formulae and their application	13
Fractions	11
Four Fundamental rules	10
H.C.F. & L.C.M.	10
Simple Quadratic Equation	9
Ratio and Proportion	8
Simple graphs of 1st degree equations	5
Directed Numbers.	5
Graphs	4
Square-root	4
Indices and Surds.	3
Graphic solution of Simultaneous equations of 1st degree ..	3
Indices, Log.	2
A.P., G.P.H.P.	1
Elimination	1

Binomial Theorem	1
Involution & Evolution	1

3. Exceptions are found in (i) the Delhi Syllabus which includes 'Involution and Evolution'; (ii) the Madras syllabus which includes binomia theorem and indices and log, (iii) Jammu & Kashmir which includes A.P., G.P., and H.P. Elimination and Indices and log (probably because mathematics is not included there in the list of optionals but it is a compulsory subject).

C. **Geometry**

1. The content in geometry indicates two broad patterns:

(a) States which divide the course under theoretical (i.e. theorems) and practical (i.e. constructions and demonstrations or experimental verification) and (b) States which emphasize only the practical aspects.

The States under category(a) are Bihar, Delhi, Gujarat, Maharashtra, Kerala, Orissa, West Bengal, Uttar Pradesh and Jammu & Kashmir. The States under category(b) are Madhya Pradesh, Assam, Punjab, Mysore, Andhra and Rajasthan. The content is arranged classwise only in Andhra Pradesh, Delhi, Kerala, Orissa, West Bengal, Uttar Pradesh and Jammu and Kashmir.

2. The content in Madhya Pradesh, Assam and Punjab is practically the same except that Assam does not mention the constructions or experiments,

which the other two do. The emphasis in these syllabuses is on basic concepts - point, line, angle, plane, solid congruency and similarity and on the following constructions: bisection of an angle and of a straight line, construction of an angle equal to a given angle, drawing perpendiculars and parallels to a given line, dividing the line in a given ratio and construction of triangles and quadrilaterals.

3. The Mysore syllabus mentions the broad topics only and not the details to be studied under each topic, as given below:

Class VIII.	Quadrilaterals and polygons;parallelgrams; rhombus,trapezium;rectangle and square; properties of parallelograms;area of squares,rectangles and trapezium, scale drawing;construction of quadrilaterals, the interior angles of a regular polygon.
Class IX.	Drawing perpendiculars and parallels using compasses, the circle, an are and a chord; a cyclic quadrilateral;to draw circle through three given points: to find the centre of a cricular are.
Class X.	The theorem of Pythagoras and its simple applications (no theoretical proof needed): simple examples on heights and distances by drawing to scale.

4. The Andhra Pradesh syllabus includes:

Class IX. Experimental verfication of the properties of angles at a points, parallel straight lines, angles of a triangle and quadrilaterals; drawing to scale.

Class X. The theorem of Pythagoras and its applications;construction of triangles, perpendiculars, bisectors of lines and angles, parallels.

Class XI. Construction of quadrilateral, drawing to scale, heights and distances involving angle of elevation and depression.

5. The Rajasthan Syllabus includes in classes IX and X the application of propositions on area of rectangles, parallelograms, the Pythagoras theorem; the circumference of a circle, area of a circle and volume of a cuboid.

6. The geometry taught in all States is the plane geometry of Euclid. To save repetition and lengthy statements, reference is being made here to theorems and problems by the numbers allotted to them in Hall and Stevens' School Geometry, a well-known text. For ready reference, again, a list is given in Appendix.

(a) Theoretical Geometry

(i) The theorems included in each syllabus and the total number of theorems to be studied in each syllabus are given below, the numbers, as has been mentioned earlier, referring to those allotted in Hall & Stevens' School Geometry (vide Appendix).

State	Theorems included in the syllabus	Total no. of theorems
Delhi	1 to 7,9,10,12,to18, 21,22,24,26,29,31,32,34, 42,to 45,	28
Uttar Pradesh	4 to 7,9,10,12,16,18,21,22, 29,31,32,38 to 46,48,49, 54 to 58	31
Bihar	4 to 7,13,14,16,18,21,22,29, 31,32,34,38 to 46,50 to 55, 60,62,63,66,	35
Gujarat& Maharashtra	5,6,12,16,21,24,26,27,31,32,	18

Orissa	1 to 17,20,21,22,23to26, 28 to 32,34,35, 38 to 49	42 (six without formal proof)
West Bengal	20,21,22,24,25,26,29to32, 34,38 to 48.	22
Madras	1 to 6,13 to 17,29,30,51 to 53,57,58.	18(15 without formal proof)
Jammu & Kashmir	1 to 7,8,9,11 to18,21,22, 24,26,27,29,30,31,34,38 to 46, 48 to 58,60,61,62,67,72,	
Kerala	1to8,13,14,16,17,18,21,22, 25,29,31,34,38to41,46,47,48.	25(17 without formal proof)
Assam	1 to 3,8,13 to 16,22.	9(all without formal proof)

(ii) It appears from the above that three theorems, nos.16,21 and 29, are included in ten States; six, nos.5,6,16,31,34 and 40 in nine States, five; nos. 22,32,38,39 and 41, in eight States; seven, nos.4,13,14 17,18,26,46 and 48 in seven States; and 11, nos.1,2,3,7,12, 24,42 to 45 and 47, in six States. Moreover, in Orissa, Madras, Kerala and Assam the formal proof of theorems is not recommended whereas other States do not clearly mention this.

(b) Practical Geometry

(i) The syllabuses for Rajasthan and Assam do not mention specifically any problems or constructions.

(ii) The problems or constructions given in others are allotted the corresponding serial number in Hall & Stevens' School Geometry(vide Appendix)

State	No.of Problems	Total No.	Additions
Andhra Pradesh	1 to 4,6,8 to 11	9	Construction of quadrilaterals and trapeziums, construction of triangles given two

			angles and one side, and the experimental verification of properties of(i) angles at a point(ii) parallel straight lines and (iii)angles of triangles and quadrilaterals.
Bihar	1 to 7,14,15,16, 17,18, 35 to 38 & iii.	16	Simple cases of construction of triangles and quadrilaterals and geometrical interpretation of ratio and proportion.
Delhi	1 to 6,25,26	8	Construction of triangles and circles.
Gujarat	1 to 7,21 to 26, 30,31	15	Construction of simple cases of triangles and the idea of similar figures.
Kerala	1,2,3,4,7, 11,12,14,15, 18,22,23,25, 26,30,37	16	Construction of triangles, quadrilaterals, circles, trapeziums;conversion of a rectilinear figure into another of equal area; formulae of area for certain figures.
Madhya Pradesh	1 to 6	6	Simple cases of construction of triangles quadrilaterals,circles and designs with geometrical figures.
Orissa	1 to 7,16 to 18, 22	12	Construction of triangles, squares,parallelograms, quadrilaterals;reduction into figures of equal area;bisection or trisection of triangles and quadrilaterals.
Punjab	1 to 6,8,9,37	9	Construction of triangles and quadrilaterals.
Uttar Pradesh	1 to 7,14,15, 18,22,23,30	13	Simple cases of construction of triangles, quadrilaterals and circles.
West Bengal	1 to 13,18,22 to 26,30,31,32,35,36,37		

(iii) Problem nos. 1,2,3,4,5,6 are the most common and are prescribed in more than 10 States.

(iv) Elementary constructions, like bisection of straight lines, arcs and angles, drawing perpendiculars to a line, making an angle equal to a given angle, finding centre of a circular arc, are common to all syllabuses.

(v) Construction of quadrilaterals and other four-sided figures are prescribed in nine States; construction of tangents to circles in six States; construction on inscribing or circumscribing circles in or about rectilinear figures and on division of a straight line in a given ratio in five States; and construction of finding a fourth, third and mean proportional to a given number of straight lines, in only one State.

D. Statistics

1. Statistics is taught only in five States-Madras, Mysore, Madhya Pradesh, West Bengal and Assam. The prescribed content is the same in Madras, Madhya Pradesh, West Bengal and Assam, and consists of: Frequency tables; averages: mean, median and mode; deviation from the mean; graphical representations-pictorial, line, bar, circle and curve line graphs; interpretation of graphs.

2. They all emphasize that statistical data should be collected by the pupils themselves.

3. Statistics is taught in class XI in Madras and Assam; and in class X in West Bengal. The Madhya Pradesh syllabus does not mention the class in which it should be taught.

4. In Mysore, the following content is included for class X: Statistical classification and tabulation; representing statistical data in column graph, sector graphs and line graphs; finding the average; elementary

treatment relating to the school and local community data.

E. Trigonometry

1. Only three States - Bihar, Madras and Jammu and Kashmir - include trigonometry in the general mathematics syllabus.

2. In Bihar, trigonometry is taught in both classes X and XI, and in Madras only in class XI.

3. The following syllabus is prescribed:

Bihar

Class X. Sexagesimal measure of an angle. Quadrants, positive and negative angles. Angles greater than four right angles.

Trigonometrical ratios. Trigonometrical ratios of an angle remain constant so long as the magnitude of the angle is constant. Formula involving trigonometrical ratios and easy identities based thereon.

Graphical determination of trigonometrical ratios of any angle, positive or negative. To express all trigonometrical ratios in terms of one trigonometrical ratio, and its applications.

Trigonometrical ratios of complementary and supplementary angles. Trigonometrical ratios of 0°, 45°, 60°, 90°, 120°, 135°, 150° and 180° to be determined geometrically and their ratios.

Radian measure of an angle. A radian is a constant angle. Value of a radian in sexagesimal measure.

In any triangle,

(i) $\frac{a}{\text{Sin } A} = \frac{b}{\text{Sin } B} = \frac{c}{\text{Sin } C}$ (ii) $c^2 = a^2 + b^2 - 2ab \cos C$

Students will be allowed to use the usual mathematical instruments.

Class XI. Angles of any magnitude;easy conditional indentities;solution of triangles; easy problems on heights and distances;graphs of six X,cos X,cosec X, sec X ten X and cot X.

MADRAS

Definition of sine, cosine and tangent of an acute angle, Trigonometrical ratios for 0°,30°,45°,60,90°.

JAMMU & KASHMIR

Measurement of angles, Trigonometrical ratios and simple relations connecting the easy applications to problems involving trigonometrical ratios of 30,45,and 60 degrees.

F. Mensuration

1. The content in mensuration is provided separately in Assam, Andhra Pradesh, Bihar, Madhya Pradesh, Mysore, Madras, Orissa and West Bengal, and included under arithmetic in Gujarat, Maharastra, Uttar Pradesh and Kerala, and under geometry in Punjab.
2. The topics common in all States, with a slight variation in the specific details, are the following:-
   - Perimeter and area of triangles, quadrilaterals, circles.

     Surface area and volume of cuboids, cubes, cylinders, cones and spheres.

The following are important additions to the above topics:

- Surface area and volume of Pyramids(in Kerala and Mysore).

-Geometry of sphere leading to definition of longitude, latitude and map projection (in Assam, Madhya Pradesh Madras and West Bengal).

-Use of Mariner's compass in knowing the direction (in Assam, Madhya Pradesh and Madras).

3. Other information given in the syllabuses is:

(i) In Assam, mensuration is given one period per week and starts in class X.

(ii) In Andhra Pradesh, mensuration is taught in each of the classes IX to XII. Only the application of formulae for surface area and volume is required.

(iii) In Bihar, mensuration is taught in class XI and only the application of formulae is required.

(iv) In Mysore, mensuration is taught in classes VIII, IX and X.

(v) In Kerala, mensuration is taught in classes X and XI.

(vi) In Uttar Pradesh, mensuration is to be offered by those students only who do not offer commerce as one of their subjects.

G. Demonstrations, Experiments and Practical Activities

1. In most syllabuses practical work is restricted to geometrical constructions and problems. Only four States mention other practical work.

MADHYA PRADESH

- Constructions and problems in geometry-
- Explation of models of geometrical figures.
- Explanation of specimen cheques, draft bills, foreign currencies, etc.

- Geometry of the sphere.
- Uses of the Mariner's compass.
- Measurement of areas of rectangular figures and triangles circumference and area of a circle.

West Bengal

- Explantion of specimen cheques;drafts;bills and foreign currencies.
- Determination of weights, heights and ages of pupils and their graphical representation.
- Explanation of models of geometrical figures.
- Measurement of areas of rectangular figure and triangles;circumference and area of circle.
- Geometry of the sphere.

GUJARAT

- Measuring an angle in a horizontal plane.
- Measuring an angle in a vertical plane.
- Location of an object inside a field from its distances from any two corners of the field.
- Location of an object by knowing its bearing from two spots in the field.
- Drawing the sketch of rectilinear field by the Methods:
  - (a) taking the bearings and distances of the different corners from a fixed point inside the field
  - (b) measruing the distances of different corners from the two ends of a given side.
  - (c) taking the bearings of each of the different corners from the two ends of a given side.
  - (d) fixing the different points by taking a base line inside the field
  - (e) measuring the lengths of sides and the turnings

at each corner running round the boundary.

(f) measuring the off-sets from a fixed base line and calculating the area of the field

- Sketching the course of a journey undertaken by noting the turnings and distances at certain stages.
- Measuring the width of a river which cannot be crossed.
- Measaring the height of a flag staff.
- Enlarging or reducing a given figure in a certain ratio on the basis of similarity of triangles.

KERALA

- Examining attractive graphs, charts, etc., usually seen in propaganda sheets of the five year plans; pictorial representations in atlases, advertisements etc., and interpreting them.
- Drawing feometrical representations(drawings card-board models, etc.) of algebraic identities.
- Examining pictures in playing cards, copies of the same photographs.
- Examining diagrams and cut-out models of different geometrical shapes.
- Examining objects of different shapes as found in nature;constructing models, especially models of hallow pyramids and cones.
- Participating activities of cooperatives in school; reading and interpreting advertisements on shares usually found in newspapers.
- Drawing and colouring beautiful patterns.

2. Most activities suggested relate to(i) work in geometry-examination of models;study of natural objects, patterns and spheres; and drawing feometrical representations,(ii)drawing of statistical graphs and their interpretation and(iii)applications of

mathematics to business.

H. Suggestions to Teachers and Authors

Only five States - Andhra Pradesh, Mysore, Kerala, West Bengal and Madras- give some suggestions to teachers or authors. In West Bengal the suggestions are common to all subjects.

ANDHRA PRADESH

(i) Stress should be laid more on the method of treatment than on the matter taught.

(ii) The problems should be simple, direct and related to life without involving multiplicity of processes.

(iii) Complicated inverse problems should be avoided, and attention should be paid to the development of skill in simple practical applications.

MYSORE

A. The approach to the subject should be:

(i) By concrete situations and pupils' experiences
(ii) By the method of 'Learning by doing'
(iii) By providing graded drill, suitable problems and tests adequately
(iv) By reviews and revisions at suitable stages
(v) Through easy problems and common situations
(vi) By practical work before tooic study, generally, and
(vii) By simple problems done at appropriate stages.

B. Learning should not be confined to the textbooks but suitably enlarged by utilizing the variety of situations that arise from time to time, such as in educational activities connected with crafts, garden work, excursions, games etc.

C. Adequate use of teaching aids and materials should be made.

KERALA

The mathematics classroom should become a laboratory where children count, compute, measure, construct a model. These learning experiences should form an integral part of the school work. Activities and some of the practical exercises may be organized in groups, taking care to provide tasks suitable to children of diverse abilities. Every child should feel that he can make a contribution to the work of the class.

The teacher should take up the various stages of a topic one by one and make sure that children have mastered a stage before passing on the next. A diagnostic test at the end of the topic will be useful to locate the difficulties of pupils and to take measures to remedy them.

To be interesting to children, mathematical principles should be introduced through practical situations and problems should be realistic and relevant to the needs of children. Correlation with other subjects of the curriculum, whenever that is possible in a natural way, can also be used as a means of creating interest.

Every attempt should be made to enable pupils to derive rules and principles inductively from concrete experiences.

Problems should be carefully graded in difficulty and should vary from easy, through medium to difficult ones, so as to suit the requirements of children of varying abilities.

The problems should, by and large, be numerically simple, so that children may not be discouraged by mistakes in calculation and develop an aversion for the subject.

The problem should call for only straight-forward applications of principles learnt.

Pupils should be familarized with the process of analysing problems.

Pupils should be instructed in the methods of verification and trained to check results after working out a problem.

For ready use in daily life whatever mathematical principles and skills are learnt should be mastered thoroughly. Tests of speed and accuracy should be frequently administered. A few minutes may be devoted every day for mental arithmetic.

MADRAS

The suggestions for teachers and textbook writers apply chiefly to the arithmetic portion of the syllabuses for the respective forms. Suggestion 5, applies to all parts of the syllabus.

1. Problems should be realistic, relevant to daily life, school activities, craft and other subjects studied in school. They should include making accounts, using real price lists, railway time-tables, etc.
2. The textbooks should provide for such problems as far as possible and practicable. The teacher should supplement these by problems specially suitable to the locality and related to the crafts common in the country.

3. Complicated inverse problems should be avoided. The pupils should reach a high level of proficiency in straight forward application of the rules and processes learnt.
4. The answers to problems need not always be exact numbers. Pupils should be given opportunities to use their judgement to give answers to a reasonable degree of accuracy.
5. From time to time pupils should be tested for speed and accuracy in the fundamental skills and should keep a record of their own performance. Textbooks should indicate such tests and also provide exercies for oral and mental work.
6. Practical work should grow out of school activities as far as possible and should form an integral part of the teaching of each topic. Most of the practical work may be done in groups. Textbooks must give suggestions about how to do the practical work and how to perform the calculations and write down the results to a reasonable degree of accuracy.
7. There should be correlation wherever possible with social studies and with general science. Alternative problems may be given for pupils taking the different diversified courses where this would be useful in the higher forms.
8. Topics need not necessarily be taken up in the order given in the syllabus; short methods should not be treated as a separate topic, but they may be taught incidentally.

9. In the proofs of geometrical theorems, pupils may be encouraged to employ algebraic manipulation, where possible.

Note: Metric units should be also used in problems in view of the introduction of metric units in the country.

WEST BENGAL

In teaching a subject, undue emphasis must not be laid on details. The broad principles and fundamentals on which the subject is based should be emphasized. "It is more important to awaken curiosity in the child's mind and teach him the methods and techniques of acquiring knowledge than to burden his mind with miscellaneous information." (Mudaliar Commission).

MAHARASHTRA

It is suggested that examples on topics in arithmetic (i.e. profit & loss, discount, exchange, stock & share, etc.) should as far as possible be correlated to the items given below:

1. Town and city taxes and Municipal budget.
2. Local fund cess and District/Local Board budget.

   Main heads of income and expenditure of State budget.

   Income tax.

   Cost of inland and foreign telegrams and cables, money orders and parcels by post, railway, steamer and air.

   Insurance-life, fire and marine.

3. No syllabus gives any specific suggestions on particular topics prescribed for study. The suggestions made are general in nature, and

speaking, are:

(a) The teaching should be meaningful and related to real-life situations.

(b) The child should be led to discover mathematical concepts and processes.

(c) The child should be able to apply mathematics in solving common problems of life.

(d) Mechancial drill work should be avoided. As far as possible, work should be restricted to simple and direct problems.

(e) In arithmetic, topics which are socially important should get greater emphasis.

These suggestion are in conformity with the pdnt of view expressed in the objectives as given in some syllabuses.

1.Equipment

The list of instruments to be used in the study of the subject is given only in two States, Kerala and Madras. The details given are as under:-

Kerala

1. Set of mathematical instruments for blackboard use	2 sets.
2. Roll up graph board(½"-squares)	3
3. Roll-up graph board(1"-squares)	3
4. 20-metre chain,cross staff,arrows, offset pole,flag staffs,scales and bits.	2 complete sets
5. Drawing boards	1 dozen
6. Clinometer	3
7. Sextant	1

8. Models of regular solids which are dissectable	2 sets

MADRAS

1. Measuring tape marked in feet and inches.(100 feet if possible).
2. Surveryor's chain, a set of arrows and tailor's measuring tape.
3. Capacity measures.
4. Letter balance and weights.
5. Market balance and weights
6. Clocks.
7. Watch showing seconds, preferably a stop watch, seconds' pendulum.
8. Wall calendars showing English and corresponding Indian almanac dates.
9. Several wooden strips or tapes marked in feet and inches to fix to the wall for measuring pupils' heights.
10. Cardboard and plywood inch squares.
11. A set of geometrical models-cube,cuboid,cylinder, cone,sphere,square,pyramid,triangular and hexagonal prism.
12. Metal straight edge.
13. Transparent squared paper (inch squares)
14. Transparent squared paper(centimetre squares)
15. A pair of compasses and dividers, protractor, yard rule, metre rule, set-square-for blackboard use.
16. Plumb line and a simple clinometer.
17. Spirit level and mason's level.
18. Cross staff.
19. Squared blackboard for graphs.

J. BOOKS

1. Andhra Pradesh, Assam, Delhi, Gujarat, Maharashtra Mysore and Orissa do not suggest any books.

2. The following States give a list of recommended books:

States	Number of books
Bihar	9
Jammu & Kashmir	2
Madhya Pradesh	2
Rajasthan	8
Uttar Pradesh	38

3. The following States list reference books:

States	Number of books
Madras	16
West Bengal	15

4. Kerala lists 33 books common to both general and composite mathematics.

APPENDIX

List of theorems and problems as given in 'A' school Geometry Parts I-V' by H S Hall, M.A., and F.H. stevens, M.A., Macmillan and Co.Limited, 1961.

LINES AND ANGLES

THEOREM 1.(Euc.1.13) The adjacent angles which one straight line makes with another straight line on one side of it are together equal to two right angles.

COR.1. If two straight lines cut one another, the four angles so formed are together equal to four right angles.

COR.2. When any number of straight lines meet at a point, the sum of the consecutive angles so formed is equal to four right angles.

COR.3 (i) Supplements of the same angle are equal. (ii) Complements of the same angle are equal.

THEOREM 2.(Euc.1.14) If, at a point in a straight line, two other straight lines, on opposite sides of it, make the adjacent angles together equal to two right angles, then these straight lines are in one and the same straight line.

THEOREM 3.(Euc.1.15) If two straight lines cut each other, the vertically opposite angles are equal.

TRIANGLES

THEOREM 4.(Euc.1.4) If two triangles have two sides of the one equal to two sides of the other, each to each, and the angles included by those sides equal, then the triangles are equal in all respects.

THEOREM 5.(Euc.1.5) The angles at the base of an isosceles triangle are equal.

COR.1. If the equal sides of an isosceles triangle are produced, the exterior angles at the base are equal.

COR.2. If a triangle is equilateral, it is also equiangular.

THEOREM 6. (Euc.1.6) If two angles of a triangle are equal to one another, then the sides which are opposite to the equal angles are equal to one another.

THEOREM 7. (Euc.1.8) If two triangles have the three sides of the one equal to the three sides of the other, each to each, they are equal in all respects.

THEOREM 8. (Eu.1.16) If one side of a triangle is produced, then the exterior angle is greater than either of the interior opposite angles.

COR.1. Any two angles of a triangle are together less than two right angles.

COR.2. Every triangle must have at least two acute angles.

COR.3. Only one perpendicular can be drawn to a straight line from a given point outside it.

THEOREM 9. (Euc.1.18) If one side of a triangle is greater than another, then the angle opposite to the greater side is greater than the angle opposite to the less.

THEOREM 10. (Euc.1.19) If one angle of a triangle is greater than another, then the side opposite to the greater angle is greater than the side opposite to the less.

THEOREM 11. (Euc.1.20) Any two sides of a triangle are together greater than the third side.

THEOREM 12. Of all straight lines from a given point to a given straight line the perpendicular is the least.

COR.1. If OC is the shortest straight line from O to the straight line AB, then OC is perpendicular to AB.

COR-2. Two obliques OP,OQ which cut AB at equal distances from C the foot of the perpendicular, are equal.

COR.3. Of two obliques OQ,OR, if OR cuts AB at the greater distance from C the foot of the perpendicular, then OR is greater than OQ.

PARALLELS

THEOREM 13. (Euc.1.27 and 28) If a straight line cuts two other straight lines so as to make (i) alternate angles equal, or (ii) an exterior angle equal to the interior opposite angle on the same side of the cutting line, or (iii) the interior angles on the same side equal to two right angles; then in each case the two straight lines are parallel.

THEOREM 14. (Euc.1.29) If a straight line cuts two parallel lines, it makes (i) the alternate angles equal to one another; (ii) the exterior angle equal to the interior opposite angle on the same side of the cutting line (iii) the two interior angles on the same side together equal to two right angles.

THEOREM 15. (Euc.1.30) Straight lines which are parallel to the same straight line are parallel to one another.

THEOREM 16. (Euc.1.32) The three angles of a triangle are together equal to two right angles.

COR.1. All the interior angles of any rectilineal figure, together with four right angles as the figure has sides.

COR.2 If the sides of a rectilineal figure, which has no re-entrant angle, are produced in order, then all the exterior angles so formed are together equal to four right angles.

THEOREM 17. (Euc.1.26) If two triangles have two angles of one equal to two angles of the other, each to each, and any side of the first equal to the corresponding side of the other, the triangles are equal in all respects.

ON THE IDENTICAL EQUALITY OF TRIANGLES

THEOREM 18. Two right-angled triangles which have their hypotenuses equal, and one side of one equal to one sides of the other, are equal in all respects.

THEOREM 19. (Euc.1.24) If two triangles have two sides of the one equal to two sides of the other, each to each, but the angle included by the two sides of one greater than the angle included by the corresponding sides of the other; then the base of that which has the greater angle is greater than the base of the other.

Parallelograms

THEOREM 20(Euc.1.33) The straight lines which join the extremities of two equal and parallel straight lines towards the same parts are themselves equal and parallel.

THEOREM 21.(Euc.1.34): The opposite sides and angles of a parallelogram are equal to one another, and each diagonal bisects the parallelogram.

COR.1. If one angle of a parallelogram is a right angle, all its angles are right angles.

COR.2. All the sides of a square are equal; and all its angles are right angles.

COR.3. The diagonals of a parallelogram bisect one another.

THEOREM 22. If there are three or more parallel straight lines, and the intercepts made by them on any transversal are equal, then the corresponding intercepts on any other transversal are also equal.

COR. In a triangle ABC, if a set of line Pp,Qq, Rr,.....,drawn parallel to the base, divide one side AB into equal parts, they also divide the other side AC into equal parts.

AREAS

THEOREM 23. AREA OF A RECTANGLE

THEOREM 24. (Euc.I.35)Parallelgrames on the same base and between the same parallels are equal in area

Area of a Prallelogram

THEOREM 25. AREA OF A TRIANGLE

THEOREM 26. (Euc.I.37) Triangles on the same base and between same parallels (hence, of the same altitude are equal in area.

THEOREM 27. (Euc.I.39) If two triangles are equal in area, and stand on the same base and on the same side of it, they are between the same parallels.

THEOREM 28. AREA OF (i) A TRAPEZIUM

(ii) ANY QUADRILATERAL

Area of any Rectineal Figure

THEOREM 29. (Euc.I.47.PYTHAGORAS'S THEOREM) In a rightangled triangle the square described on the hypotenuse is equal to the sum of the squares described on the other two sides.

Experimental Proofs of Pythagoras's Theorem.

THEOREM 30.(Euc.I.48) If the square described on one side of a triangle is equal to the sum of the squares described on the other two sides, then the angle contained by these two sides is a right angle.

The Circle Chords

THEOREM 31. (Euc.III.3) If a straight line drawn from the centre of a circle bisects a chord which does not pass through the centre, it cuts the chord at right angles.

Conwersely, if it cuts the chord at right angles, it bisects it.

COR.I. The straight line which bisects a chord at right angles passes through the centre.

COR.2. A straight line cannot meet a circle at more than two points.

COR.3. A chord of an circle lies wholly within it.

THEOREM 32. One circle, and only one, can pass through any three points not in the same straight line.

COR.1, The size and position of a circle are fully determined if it is known to pass through three given points.

COR.2. Two circles cannot cut one another in more than two points without coinciding entirely.

THEOREM 33. (Euc.III.9) If from a point within a circle more than two equal straight lines can be drawn to the circumference, that point is the centre of the circle.

THEOREM 34. (Euc.III.14) Equal chords of a circle are equidistant from the centre.

Conversely, chords which are equidistant from the centre are equal.

THEOREM 35. (Euc.III.15) Of any two chords of a circle, that which is nearer to the centre is greater than one more remote.

Conversely, the greater of two chords is nearer to the centre than the less.

COR.The greatest chord in a circle is a diameter.

THEOREM 36. (Euc.III.7) If from any internal point, not the centre, straight lines are drawn to the circumference of a circle, then the greatest is that which passes through the centre, and the least is the remaining part of that diameter. And of any other two such lines the greater is that which subtends the greater angle at the centre.

THEOREM 37. (Euc.III.8) If from any external point straight lines are drawn to the circumference of a circle, the greatest is that which passes through the centre, and the least is that which when produced passes through the centre. And of any other two such lines, the greater is that which subtends the greater angle at the centre.

ANGLES IN A CIRCLE

THEOREM 38. (Euc.III.20) The angle at the centre of a circle is double of an angle at the circumference standing on the same arc.

THEOREM 39. (Euc.III.21) Angles in the same segment of a circle are equal.

Converse of Theorem 39. Equal angles standing on the same base, and on the same side of it, have their vertices on an arc of a circle of which the given base is the chord.

THEOREM 40. (Euc.III.22) The opposite angles of any quadrilateral inscribed in a circle are together equal to two right angles.

CONVERSE OF THEOREM 40. If a pair of opposite angles of a quadrilateral are supplementary, its vertices are concylic.

THEOREM 41. (Euc.III.31) The angle in a semi-circle is a right angle.

COR. The angle in a segment greater than a semicircle is acute; and the angle in a segment less than a semi-circle is obtuse.

THEOREM 42. (Euc.III.26) In equal circles, arcs which subtend equal angles, either at the centres or at the circumferences, are equal.

COR. In equal circles sectors which have equal angles are equal.

THEOREM 43. (Euc.III 27) In equal circles angles, either at the centres or at the circumferences, which stand on equal arcs are equal.

THEOREM 44. (Euc.III 28) In equal circles, arcs which are cut off by equal chords are equal, the major are equal to the major arc, and the minor to the minor.

THEOREM 45. (Euc.III.29) In equal circles chords which cut off equal arcs are equal.

Tangency

THEOREM 46. The tangent at any point of a circle is perpendicular to the radium drawn to the point of contact. COR.I. One and only one tangent can be drawn to a circle at a given point on the circumference.

COR.2. The perpendicular to a tangent at its point of contact passes through the centre.

COR.3. The radium drawn perpendicular to the tangent passes through the point of contact.

THEOREM 47. Two tangents can be drawn to a circle from an external point.

COR. The two tangents to a circle from an external point are equal, and subtend equal angles at the centre.

THEOREM 48. If two circles touch one another, the centres and the point of contact are in one straight line.

COR. 1. If two circles touch externally the distance between their centres is equal to the sum of their radii.

COR. 2. If two circles touch internally, the distance between their centres is equal to the difference of their radii.

THEOREM 49. (Euc.III.32) The angles made by a tangent to a circle with a chord drawn from the point of contact are respectively equal to the angles in the alternate segments of the circle.

Geometrical Equivalents of Some Algebraical Formula

THEOREM 50. (Euc.II.1) If of two straight lines, one is divided into any number of parts, the rectangle contained by the two lines is equal to the sum of the rectangles contained by the undivided line and the several parts of the divided line.

COROLLARIES (Euc.II,2 and 3)

THEOREM 51. (Euc.II,4) If a straight line is divided internally at any point, the square on the given line is equal to the sum of the squares on the two segments together with twice the rectangle contained by the segments.

THEOREM 52. (Euc.II.7) If a straight line is divided externally at any point, thesquare on the given line is equal two the sum of the squares on the two segments diminished by twice the rectangle contained by the segments.

53. THEOREM

THEOREM 53. (Euc.II 5 and 6) The difference of the squares on two straight lines is equal to the rectangle contained by their sum and difference.

COR. If a straight line is bisected, and also divided (internally or externally) into two unequal segments, the rectangle contained by these segments is equal to the difference of the squares on half the line and on the line between the points of section.

THEOREM 54. (Euc.II.12) In an obtuse-angled triangle, the square on the side subtending the obtuse angle is equal to the sum of the squares on the sides containing the obtuse angle together with twice the rectangle contained by one of those sides and the projection of the other side upon it.

THEOREM 55. (Euc.II.13) In every triangle the square on the side subtending an acute angle is equal to the sum of the squares on the sides containing that angle diminished by twice the rectangle contained by one of those sides and the projection of the other side upon it.

THEOREM 56. In any triangle the sum of the squares on two sides is equal to twice the square on half the third side together with twice the square on the median which bisects the third side.

RECNTANGLES IN CONNECTION WITH CIRCLES

THEOREM 57. (Euc.III.35) If two chords of circle cut at a point within it, the rectangles contained by their segments are equal.

THEOREM 58. (Euc.III.36) If two chords of a circle, when produced, cut at a point outside it, the rectangles contained by their segments are equal. And each rectangle is equal to the square on the tangent from the point of intersection.

THEOREM 59. (Euc.III.37) If from a point outside a circle two straight lines are drawn, one of which cuts the circle, and the other meets it; and if the rectangle contained by the whole line which cuts the circle and the part of it outside the circle is equal to the square on the line which meets the circle, then the line which meets the circle is a tangent to it.

PROPORTIONAL DIVISION OF STRAIGHT LINES

THEOREM 60. (Euc.VI.2) A straight line drawn parallel to one side of a triangle cuts the other two sides, or those sides produced proportionally.

THEOREM 61. (Euc.VI.3 and A). If the vertical angle of a triangle is bisected internally or externally, the bisector divides the base internally or externally into segments which have the same ratio as the other sides of the triangle.

Conversely, if the base is divided internally or externally into segments proportional to the other side of the triangle, the line joining the point of section to the vertex bisects the vertical angle internally or externally.

Equiangular Triangles

THEOREM 62. (Euc.VI.4) If two triangles are equiangular to one another, their corresponding sides are proportional.

THEOREM 63. (Euc.VI.5) If two triangles have their sides proportional when taken to order, the triangles are equiangular to one another, and those angles are equal which are opposite to corresponding sides.

THEOREM 64. (Euc.VI.7) If two triangles have one angle of the one equal to one angle of the other, and the sides about the equal angles proportionals, the triangles are similar.

THEOREM 65. (Euc.VI.7) If two triangles have one angle of the one equal to one angle of the other, and the sides about another angle in one proportional to the corresponding sides of the other, then the third angles are either equal or supplementary; and in the former case the triangles are similar.

THEOREM 66. (Euc.VI.8) In a right-angled triangle, if a perpendicular is drawn from the right angle to the hypotenuse, the triangles on each side of it are similar to the whole triangle and to one another.

SIMILAR FIGURES

THEOREM 67. Similar polygons can be divided into the same number of similar triangles; and the lines joining corresponding vertices in each figures are proportional.

THEOREM 68. Any two similar rectilineal figures may be so placed that the lines joining corresponding vertices are concurrent.

THEOREM 69. (Euc.VI.33) In equal circles, angles whether at the centres or circumferences, have the same ratio as the arcs on which they stand.

PROPORTION APPLIED TO AREAS

THEOREM 70. (Euc.VI.1) The areas of triangles of equal altitude are to one another as their bases.

THEOREM 71. If two triangles have on angle of the one equal to one angle of the other, their areas are proportional to the rectangles contained by the sides about the equal angles.

THEOREM 72. (Euc.VI.19) The areas of similar triangles are porportional to the squares on corresponding sides.

THEOREM 73. (Euc.VI.20) The areas of similar polygons are proportional to the squares on corresponding sides.

THEOREM 74. (Euc.VI.31) In a right-angled triangle, any rectilineal figure described on the hypotenuse is equal to the sum of the two similar and similarly described figures on the sides containing the right angle.

RECTANGLES IN CONNECTION WITH CIRCLES

THEOREM 75. (Euc.III.35 and 36) If any two chords of a circle cut one another internally or externally, the rectangle contained by the segments of one is equal to the rectangle contained by the segments of the other.

COR. If from an external point a secant and a tangent are drawn to a circle, the rectangle contained by the whole secant and the part of it outside the circle is equal to the square on the tangent.

THEOREM 76. If the vertical angle of a triangle is bisected by a straight line which cuts the base, the rectangle contained by the sides of the triangle is equal to the rectangle contained by the segments of the base, together with the square on the straight line which bisects the angle.

THEOREM 77. If from the vertical angle of a triangle a straight line is drawn perpendicular to the base, the rectangle contained by the sides of the triangle is equal to the rectangle contained by the perpendicular and the diameter of the circum-circle.

THEOREM 78. (Ptolemy's Theorem) The rectangle contained by the diagonals of quadrilateral inscribed in a circle is equal to the sum of the two rectangles contained by its opposite sides.

PROBLEMS ON LINES AND ANGLES

Problem 1. To bisect a given angle.

Problem 2. To bisect a given straight line.

PROBLEM 3. To draw a straight line perpendicular to a given straight line at a given point in it.

PROBLEM 4. To draw a straight line perpendicular to a given straight line from a given external point.

PROBLEM 5. At a given point in a given straight line to make an angle equal to a given angle.

PROBLEM 6. Through a given point to draw a straight line parallel to a given straight line.

PROBLEM 7. To divide a given straight line into any number of equal parts.

THE CONSTRUCTION OF TRIANGLES

PROBLEM 8. To draw a triangle, having given the lengths of the three sides.

PROBLEM 9. To construct a triangle having given two sides and an angle opposite to one of them.

PROBLEM 10. To construct a right-angled triangle having given the hypotenuse and one side.

The Construction of Quadrilaterals.

PROBLEM 11. To construct a quadrilateral, given the lengths of the four sides, and one angle.

PROBLEM 12. To construct a parallelgram having given two adjacent sides and the included angle.

PROBLEM 13. To construct a square on a given side

LOCI

PROBLEM 14. To find the locus of a point P which moves so that its distances from two fixed points A and B are always equal to one another.

PROBLEM 15. To find the locus of a point P which moves so that its perpendicular distances from two given straight lines AB, CD are equal to one another.

I

Intersection of Loci

The Concurrence of Straight Lines in a Triangle

1. The perpendiculars drawn to the sides of a triangle from their middle points are concurrent.

II. The bisectors of the angles of a triangle are concurrent.

III. The medians of a triangle are concurrent.

COR. The three medians of a triangle cut one another at a point of trisection, the greater segment in each being towards the angular point.

PROBLEM 16. To draw squares whose areas shall be respectively twice, three-times, four times..... that of a given square.

Problems on Areas

PROBLEM 17. To describe a parallelogram equal to a given triangle, and having one of its angles equal to a given angle.

PROBLEM 18. To draw a triangle equal in area to a given quadrilateral.

PROBLEM 19. To draw a parallelogram equal in area to a given rectilineal figure, and having an angle equal to a given angle.

GERMETRICAL ANALYSIS

PROBLEM 20. Given a circle, or an arc of a circle, to find its centre.

PROBLEM 21. To bisect a given arc.

PROBLEM 22. To draw a tangent to a circle from a given external point.

THE CONSTRUCTION OF CIRCLES

PROBLEM 24. On a given straight line to describe a segment of a circle which shall contain an angle equal to a given angle.

COR. To cut off from a given circle a segment containing a given angle, it is enough to draw a tangent to the circle, and from the point of contact to draw a chord making with the tangent an angle equal to the given angle.

CIRCLES IN RELATION TO RECTILINEAL FIGURES

PROBLEM 25. To circumscribe a circle about a given triangle.

PROBLEM 26. To inscribe a circle in a given triangle.

PROBLEM 27. To draw an escribed circle of a given triangle.

PROBLEM 28. In a given circle to inscribe a triangle equiangular to a given triangle.

PROBLEM 29. About a given circle to circumscribe a triangle equiangular to a given triangle.

PROBLEM 30. To draw a regular polygon (i) in (ii) about a given circle.

PROBLEM 31. To draw a circle (i) in (ii) about a regular polygon.

PROBLEM 32. To draw a square equal in a area to a given rectangle.

PROBLEM 33. To divide a given straight line so that the rectangle contained by the whole and one part may be equal to the square on the other part.

PROBLEM 34. To draw an isosceles triangle having each of the angles at the base double of the vertical angle.

PROBLEM 35. To find the fourth proportional to three given straight lines.

PROBLEM 36. To find the third proportional to two given straight lines.

PROBLEM 37. To divide a given straight line internally and externally in a given ratio.

PROBLEM 38. To find the mean proportional between two given straight lines.

PROBLEM 39. On a side of given length to draw a figure similar to a given rectilineal figure.

PROBLEM 40. To draw a figure similar to a given rectilineal figure, and equal to a given fraction of it in area.

CURRICULUM AND TEACHING OF MATHEMATICS
IN THE
HIGHER SECONDARY SCHOOLS

AN ANALYSIS OF
TEXTBOOKS IN GENERAL MATHEMATICS

MONOGRAM

NIE - HEW - 009
Department of Curriculum and Evaluation
(National Council of Educational Research & Training)
NIE Campus, Mehrauli Road, New Delhi-16.

CONTENTS

Introduction 1

General Information 4-7

  Authorship 4

  Quality of paper 5

  Number of pages 5

  Printing Errors 6

  Language 7

General Organization of the Textbook 7

Subject Matter 8-10

Exercises 9

Test papers 10

Problems 10

Units of Measurement 10

Style of Writing 11

Pictorial and Graphic Illustrations 11

Objectives 12

Miscellaneous 12-16

Appendix I 17

Appendix 2 19

Appendix 3 26

INTRODUCTION

This brief report is an analysis of 43 books in elementary mathematics that are in use in various states of the country. The purpose of this study was to get an analytical opinion of the teachers about the books in use. The textbook in most cases is the only source of material for instruction. It provides suggestions for development of processes, practice exercises, study helps and tests. It was felt that the analytical opinion of the teachers on these aspects of the textbook will be of immense value in preparing instructional material on the topics included in the curriculum guide.

Tool used:

The tool used for this study was a questionnaire for teachers. (See Appendix 2.)

Development and description of tool:

Whoever sets out to measure the qualities of a textbook soon discovers that not all its qualities are measurable and no scientifically evolved standards or norms exist for measuring these qualities. Much reliance is to be placed upon the judgement and experience of the examiner. The examiner should know the textbook and the school conditions, and should have a set of mental stndards by which to judge the various qualities. It was, therefore, thought appropriate to request school teachers to give their opinions on the books they used in class.

To secure uniformity in information a questionnaire was prepared by the project staff and for this purpose, a preliminary survey of about 30 mathematics books was done. This survey helped in deciding about the various aspects of a textbook on which the questions could be organized and in listing items that could go under each aspect. It was soon realized that to have a detailed analysis or to cover every type of information in a textbook, it was necessary to work out lengthy analysis sheets, which will take a good amount of time to fill in. Since the purpose was not to compare one set of books with another, it was decided not to have very detailed analysis sheets. On the other hand, it was felt that the opinion of the teacher on the aspects of the book

PTO

he used could best be obtained through a few open-ended question.

The first draft of the questionnaire prepared by the project staff was sent to 20 experienced school teachers and lecturers in colleges for their comments. It was then modified in the light of the suggestions received. These changes were very minor and did not change in any way the structure of the original.

The questionnaire used in this study was organized under the following heads:

- A. General Information: authorship; paper and printing; printing errors; Language of the book, etc.
- B. General Organization of the Textbook: conformity of the textbook to the syllabus; sequence of topics treated, etc.
- C. Subject-matter: type of material - solved examples, practice excercises, problems, test papers, revision exercises, etc.
- D. Style of Writing: presentation of topics; explanation of concepts; quality of language used, etc.
- E. Pictorial and Graphic Illustrations: appropriateness and accuracy of illustrations and their contribution to the understanding of mathematical ideas.
- F. Miscellaneous: three open-ended questions on i) the continuity of topics from grade to grade; ii) the type of material that the textbook should include; and iii) the over-all opinion of the teacher.

The Sample:

The questionnaire was sent to about 200 school teachers who were requested to fill in the information with regard to the textbook that is in actual use for teaching elementary mathematics. Response to the questionnaires was not very prompt and reminders were sent to the persons who did not respond. After waiting for a fairly long time (about 3 months) only 60 questionnaires were received back from the teachers. A close scrutiny of these questionnaires revealed that in 17 cases the teachers had sent information on a book that was in use in a lower class or for teaching optional or advanced mathematics. Therefore for the final analysis only 43 questionnaires were found relevant. The state-wise distribution of these questionnairs is as follows:-

1.	Andhra Pradesh	1	5.	Jammu & Kashmir	2
2.	Assam	3	6.	Kerala	2
3.	Bihar	1	7.	Mysore	2
4.	Gujarat	8	8.	Madhya Pradesh	4

PTO

9.	Madras	2	12.	Rajasthan	9
10.	Orissa	4	13.	Uttar Pradesh	1
11.	Punjab	2	14.	West Bengal	2

Since the questionnaire did not go into the details of the sources of problems and their adequacy, a detailed analysis of 28 books was done by the research staff. The data collected for 9 topics are presented in the Appendix 3.

The procedure of Analysis:

The information obtained on each questionnaire was transferred to a single sheet for each category for the purpose of drawing conclusions.

The interpretation suffers from the limitations that accrue to the questionnaire technique of study. In some cases the answers were vague and inconsistent. The interpretation of the information supplied by teachers is given in the following pages.

A. GENERAL INFORMATION

Authorship

Many things are expected of a person who writes a textbook. His obligations are not confined to mere compilation of information regarding the subject-matter but extend along many avenues - the promotion of effective teaching-learning situations, discriminating between the important and the unimportant within the subject, and helping pupils achieve the objectives of the subject. The author of the textbook must therefore possess several qualities. Thorough knowledge of the subject-matter is a sine qua non for him. He should know the pupils for whom he wants to write -their nature, needs and interests. In addition, he should possess a style of writing which will make his book readable. In order to organize and present the content in a more effective manner the textbook author should remain vigilant in achieving the objectives, providing exercises and activities which will produce the desired understandings and skills, anticipating specific difficulties of pupils, adopting devices and illustrations, and many other such things.

Usually a single author does not have all these qualities. If the author is a school teacher he knows better about the pupils but is likely to be out of touch with the recent developments in the subject and thus is poor in the knowledge of the subject. On the other hand, if the author is a scholar or a university teacher, he does not know the school children so well. There is, therefore, need for collaboration between the two. The collaboration of an experienced training college teacher, who can help in suggesting suitable methods of presentation may also be helpful.

From this point of view the knowledge of existing pattern of authorship in our textbooks would be interesting to know.

Data about Authors

Out of 43 books in the sample, three books do not give any information about their authors. Two of them are published by the State Governments and have been written by authors appointed by the State. Of the rest, 14 books have been written by single authors, 21 by two authors and three by three authors. Thus, nearly 60%

textbooks have been written by joint authors.

No information is given about the teaching experience of the author or the institution in which he works. Only their names and degrees are given. 11% of these authors have a doctoral degree, 69% are trained and possess a B.Ed., B.T. or C.T. degree. 17% have a master's degree and no degree in teaching. The subject of the master's degree is also not given. 37% hold a master's degree in the subject and are trained.

The various patterns in qualifications are M.A., B.T.; M.A., B.Ed.; M.A., M.Ed.; M.A., C.T.; M.Sc., B.Ed; M.A. or MSc.; B.A., B.Ed.; B.A., C.T.; B.Sc., M.Ed.; B.A., D.Sc.

The most popular patterns are M.A., B.T.; M.A. or M.Sc; B.A. B.Ed. In case of joint authorship in only one case none of the authors is trained, in other cases at least one of authors is.

Quality of paper

The physical or mechanical features of a textbook include the number of pages, page-size, binding, paper, print, etc. These physical aspects contribute to the readability and usability of the textbook. If the paper is of good quality, printing will be clear and attractive and the book will last longer. The price of the book also depends on the quality of the paper.

Nearly 72% of the books in the sample are reported to have used white paper whichis not likely to wear out easily, 23% white paper which is likely to wear out easily and 5% yellowish paper which is not likely to wear out easily. On the whole, we can therefore say, the paper used in these books is of good quality and also durable.

Number of Pages

The number of pages has a two-fold significance. Firstly, it affects the price of the book. A book containing more pages will be priced higher than one with fewer pages. Secondly, it determines the quantity of content proposed for study. The practice of giving page-to-page assignment is very common with mathematics teachers and so the number of pages determine the amount of material that the pupils are expected to learn. The textbooks in the present sample differ in the areas of mathematics they deal with and the number of years for which they are used. The sample included textbooks on arithmetic, geometry, algebra and general methamatics (in which all the different branches are put together in one volume). Some of the books in the sample are used for one year, some for two years and others for three years. The range of the number of pages for the sample understudy is as follows:

Books on/ No. of Years	General Maths.	Arithmetic	Geometry	Algebra
1	166-302	80-139	88	102-131
2	212-602	716	186-322	175-536
3	278-431	526-656	204-336	523-626

It is impossible to generalize any pattern from the above table. It is, however, clear that in terms of the number of pages the load on the pupils is quite heavy. The books used for three years seem to be quite bulky. The load will be fairly heavy where separate books for Arithmetic, Geometry and Algebra are used.

Printing Errors

No textbook must contain printing mistakes, and then, they become vital in a Mathematics textbook. Complaints about answers given in the book not tallying with those arrived at by the pupils are not uncommon. In the present sample of 43 books, it is reported that 23 books contain printing errors, the range of the number of errors being from 3 to 100.

No. of Errors	No. of Books
0-10	9
11-20	6
21-30	3
31-40	4
100	1

Date of Publication

The textbook in mathematics should be up to date both in the mathematical content and in the social applications of mathematics. It was, therefore, thought useful to collect the following information on the books in the sample.

PTO

in mathematics, may be due to the High School and Higher Secondary pattern of schooling or diversification in courses, there is only one book covering all the topics included in the various syllabuses. The additional topics included in these books are: Difficult sums on Volume, Capacity, Insurance, Banking, Foreign Exchange; Proofs of the theorems; Deduction and construction problems; Approximation; Intersection of Circles; Tangent.

Mathematics is a sequential subject and the learning of a new concept is intimately connected with those already learnt. It is, therefore, necessary that the mathematics textbooks should present topics and concepts in proper order so that at any stage the learning is not impaired. In most books in the sample the sequence of topics is satisfactory and only in 10, it is not so. In Arithmetic the reorganization is suggested by way of shifting the application topics such as banking, insurance, household accounts to a stage later than topics such as average, percentage, etc. In Algebra it is suggested that 'harder cases of equations, fractions and harder problems' should be shifted to a later stage and statistical graphs should preceed algebraic graphs. In Geometry the area and volume of circle should be shifted to a later stage.

C. SUBJECT MATTER

Since in practically all cases the textbook relates to a specific syllabus, and most of the syllabuses only mention topics, it is only through the prescribed textbook that the teacher gets an idea of the scope of various topics and the level of difficulty at which the topics are to be treated. He uses textbooks for the development of a new topics, for practice on a topic already introduced, for revision of the topics, for planning the examination, for assigning home work and for many other instructional activities. The usefulness of the textbook, therefore, very much depends upon the extent it meets the requirements of the various instructional activities.

The subject matter in the books under study consisted of:

		No. of books
a)	Description in narrative form	83.7%
b)	Illustrative solved examples	90.7%
c)	Practice excercises	93.6%

PTO

a) The date of publication of the first edition is not given in six textbooks in the sample. Out of the rest, I book was published before 1950, 5 during 1950-54, 12 during 1955-1959, 19 during 1960-64.

b) The date of publication of the latest edition is not given in seven textbooks in the sample. Out of the rest, I book is dated 1954 edition; 3 books, 1961; 7 books 1962; 6 books, 1963; and 19 books, 1964.

It is not clear from the information available whether the edition in use is revised or simply a reprint of an older edition.

(c) The number of editions published so far is not mentioned in 12 textbooks. Out of the rest, four books are running in the first edition, 9 books in the second, 5 books in the third, 3 books in the fourth, 6 books in the fifth, 2 books in the twelfth, and 1 each in the eleventh and the fourteenth.

Language of the books.

Out of the 43 books in the sample, 36 books were originally written in a regional language and the remaining 7 were written originally in Englsih and translated into the regional languages. One book written originally in English has been translated into two and another into four regional languages.

B. GENERAL ORGANIZATION OF THE TEXTBOOK.

In most of our schools the pattern of teaching is determined by the organization of thetextbook used by the teachers. Almost all teachers teach the prescribed textbook and few consult the syllabus or the curriculum. Moeover, most syllabuses are too brief to clearly indicate the scope of the topics. This is why the teachers depend entirely upon the textbook and use it slavishly.

All the books in the sample strictly follow a syllabus prescribed by a Board of Secondary Education/Stage Govt./ Education Department/University. Each book covers all the topics included in the syllabus it follows. Only seven books in the sample have topics which are not in the syllabus. The main reason for this seems to be that in States where there is more than one course

d)	Answers to sums in exercises	81.4%
e)	Exercises for revision	55.8%
f)	Test papers	55.8%
g)	Answers to sums in test papers	58.1%
h)	Question papers of Boards and Universities	39.6%
i)	Discussion in question-answer form	18.7%
j)	Diagnostic tests	11.5%

It is thus clear that most of the books contain some descriptive material mainly consisting of definitions of new terms, solves examples illustrating computational skills and problems situations and exercises for practice with their answers. Less than 20% books contain discussion in question-answer form and diagnostic tests. It is, therefore, quite likely that pupils do not get training in raising questions and finding out answers to them as they read the book and merely memorize the various constituent elements of the content arranged according to logical sequence. Teachers are also not provided with suggestions to test the outcomes of instruction and learning as evidenced in the behaviour of the pupils.

Solved examples and practice exercises

Solved examples and practice exercises are fairly tied together in the sense that both are arranged according to levels of difficulty in computation. In some books even the correspondence between the solved example and the practice exercises of the same type is indicated. This leaves very little initiative to pupils to think about the basic concepts, relationships and principles because they can always solve a set of exercises by substituting the figures in the model solution for those given in the solved example. Thus the setting for learning provided in textbooks leaves little scope for choice of methods and the manner in which the answers to sums can be obtained. In about 25% books it was reported that solved examples do not clarify concepts and so the books are of little value for a bright student to study on his own from the book. A number of errors were also reported in the exercises, the range being from 3 to 100.

Revision Exercises

Nearly 60% books contain revision exercises which are, in most cases, given at the end of a topic or after all the topics have been covered. The sums in these exercises are arranged accordingly to levels of difficulty. In cases where they are given after all the topics have been covered the order of topic is not often taken into consideration in listing the sums. The purpose of revision exercises is not clear; they only appear to give

PTO

extra practice in solving typical sums.

Test papers

Nearly 60% books contain test papers which are mostly given at the end of the book, their ovious purpose appearing to be preparation of pupils for examintions. The sums included are selected from the point of view of their relative worth for examinations. In nearly 40% books question papers of a Board or university set in previous years are also given. These papers provide supplementary practice material and a strong motive to achievement.

Problems

Problems have an important place in the content material of a mathematics textbook. In all the books in the sample, problems are provided but no book encourages problem-solving as a method of learning mathematics. Although there are in exercises exclusive sums for computation, in the problems too there is more emphasis on computational complexities. By all such exercises for study which go by the name of 'problems', the books do not encourage the child to study the situation. Each problem is an isolated problem in the sense that the situation presented in it differs from the situation preseneted by the preceeding or the succeeding problem with regard to the source of the situation or the type of activity involved or both. About only 28% books in the sample it was reported that most of the problems in them are related to everyday life activities. In another 65% books only a few problems were reported to be related to life activities.

In some cases a few absurdities in the problems were reported. Such absurdities which occur mostly in problems on prices and measurements of things make them quite unreal for pupils. Then, the answers expected of the problems are mostly exact and do not encourage skills of approximation or rounding off.

Units of Measurement.

We have recently switched over to metric system of weights and measures and it is expected that pupils will get adequate practice in computing with metric units. However, at the higher secondary stage, pupils should also be acquainted with measures other than metric. It was with a view to know the practice followed by authors that this question was asked. In one case there was no response. Out of the remaining 42 books, three still continue to use British measures, only twenty one use metric measures and eighteen use both the measures.

PTO

D. STYLE OF WRITING

The subject-matter of mathematics is abstract in nature and hence, the manner in which it has been written has great significance. If the book is easy to read and catches the attention of the pupil the learning will be greatly facilitated. The language used should be simple and within the comprehension level of average pupil. The idea should be directly and clearly expressed and they should follow each other logically. Inaccuracies in language often fail to make concepts clear. Another aspect of language in mathematics books is the language of mathematics itself, i.e. its symbols, signs and terms. Technical terms should be properly explained and should also be repeated several times in different settings.

In 60% books in the sample the language was reported to be within the comprehension level of an average student. In another 36% books it was not always so. In the absence of any wordcount or vocabulary study, it is difficult to exactly determine the suitability of the language.

The most commonly used methods for explaining the concepts as reported are:

i) Descriptive - direct narration
ii) Solved examples and
iii) Sums.

Assuming that each concept is a generalization, it is clear that books do not provide opportunity to the pupils to explore the thought elements in the definitions or concepts. However, in 85% books the concepts were reported to have been clearly and definitely explained. The responses to question, 'Are the principles involved in a topic discussed in all possible manipulative forms', are evenly balanced.

E. PICTORIAL AND GRAPHIC ILLUSTRATIONS

Pictorial and graphic illustrations constitute the main aids in in textbooks. They provide scope to cultivate the power of visualizing the number and spatial relationships and to develop skills in representing data symbolically. Good illustrations stimulate thought and imagination. All this is possible only if the illustrations are accurately drawn and are sufficiently attractive to stimulate children. In case of five books out of the 43 books in the sample, no information was given in this regard. On the rest, the illustrations were reported adequate in 67% of the books and inadequate in 33%.

PTO

In nearly 90% books the illustrations were reported to be accurate. The following are some of the wasy in which, in teachers' opinion, the illustrations contribute to the understanding of the subject.

a) They serve as visual aid

b) They make the comprehension of problems easier

c) They explain how concepts are related to rea-life situations

d) They hold the attention of dull students as well

e) They help in the understanding of principles and relationships between concepts and processes.

Illustrations were reported to be of special significance in topics such as Time & Work, Time & Distance, Graphs and in Geometry.

F. Objectives

It is imperative that before begining to write a book the author should keep some objectives which he desires to achieve through it. The objectives indicate the knowledge he desires to impart, his views on the child and how learning takes place, and should govern his presentation.

60% books in the sample were reported to have given the objectives in the preface. In 20% of these books no response was given to the question, 'Does the treatment of the subject in the book help the achievement of the objectives stated in the preface?'. In 29% books the treatment helps in the achievement of the objectives, in 41% only partly, and 10% not at all.

In nearly 80% books, it was reported, that the treatment of the book helps in the achievement of the objectives given in the syllabus. However, only 35% books were reported to help in the achievement of the objectives of teaching mathematics and 60% books were reported to do so partly.

G. Miscellaneous

As this section had three open-ended question, the answers did not have a common pattern. The response to the question: Are the textbooks of the same author used in different grades of your school are evenly balanced. In 14 cases the books of the same author(s) were used only in Secondary classes, i.e., VIII, IX, X or XI. In five cases the books of the same author were used in lower classes V, VI, VII or VIII as well. In only one case (where the books are

PTO

nationalised) the same series was used in all classes. In one case where the names of the author is not given, books of the same publisher were reported to be in used in other grades at the Secondary level.

In most of the cases no definite response was given to the question: How is the continuity maintained from grade to grade? There are only three opinions worth noting, but since these have been given by a few teachers only, they may not be accepted as a general response. These are: Continuity from grade to grade is maintained by

i) following the syllabus strictly from grade to grade

ii) arranging the problems from simple to difficult - - simple problems in lower grades and difficult in higher

iii) providing for revision exercises in each grade.

In answering the second question: 'Which of the following things would you like to include in the present book?', the teachers were allowed to indicate more than one choice. Their responses when taken together indicate the following order among the items suggested.

	Item	No. of responses
a)	Practical problems from life situations	32
b)	Topicwise tests	30
c)	Concept-wise practice items	24
d)	More sums for drilling	20
e)	Chapter-wise summary giving terms and principles involved	19
f)	Term test papers	18
g)	Mathematical tables	13
h)	Others:	
	i. Objective-type test	5
	ii. Board/university papers	1
	iii. Diagnostic tests	1
	iv. Revision exercises	1
	v. Model test	1

In the last item of the questionnaire, the teachers were asked to give their considered opinion regarding the book in a few paragraphs. Most of the responses to this question were very sketchy and brief and consisted of some rating of the book in general terms and comments upon a few things that the book should or should not include. A summary of the responses giving what the teachers liked (A) and disliked (B) in the books is presented here category-wise. (The figure inside brackets indicate the number of responses).

General rating of the books

i)	Suitable and useful	(10)
ii)	Satisfactory	(6)
iii)	tolerable	(5)
iv)	best book in the State	(4)
v)	popular among teachers and pupils	(2)
vi)	self-sufficient	(1)
vii)	easy and simple	(1)
viii)	unsatisfactory to develop mathematical aspects	(3)
ix)	needs review in the light of modern methods of teaching	(1)
x)	not according to syllabus	(1)

Physical aspect

A		B	
i) No printing errors	(2)	i) Unsatisfactory quality of paper	(3)
ii) Correct answers	(1)	ii) A vast number of printing errors	(1)
iii) Few printing errors	(1)	iii) Higher price	(2)
		iv) Wrong abbreviations for units	(1)

Subject matter

A		B	
i) Exercises graded	(5)	i) Exercises not graded	(4)
ii) Interesting explanations	(4)	ii) Insufficient number of sums for practice	(1)
iii) Matter suited to average students	(4)	iii) Content from Arithmetic Algebra and Geometry should be integrated	(1)
iv) Sufficient solved examples	(2)	iv) No thought-provoking problems	(1)

Style of writing

A		B	
i) Explanations clear	(1)		
ii) Special methods used by authors	(1)	Nil	

Objectives

A	B	
Nil	i) Does not provide for applications	(2)
	ii) Does not provide for mathematical skills	(1)

In giving their overall opinion about the books teachers have also indicated what in their opinion the book should or should not include. In some cases teachers have repeated the same things that they had suggested in answer to former questions. Their responses are listed here.

1. To be included in the book.

i) Sums from practical life situations	(7)
ii) Test items	(6)
iii) Revision exercises	(4)
iv) Pictorial or graphic illustrations	(3)
v) Use of algebraic methods in solving problems	(2)
vi) New units of measure	(2)
vii) More solved examples	(2)

viii) Correlation with other subjects	(1)
ix) Oral and mental work	(1)
x) Material from history of Mathematics	(1)
xi)Objectives of teaching	(1)
xii)Analysis of problems	(1)
xiii)Answers to problems	(1)
xiv) Question papers	(1)
2. To excluded from the book:	
i) Lengthy descriptions	(1)
ii) Lengthy exercises	(1)
iii) Decimals	(1)
iv) H.C.F. and L.C.M.	(1)
v) Four simple rules	(1)
vi) Some unnecessary formula	(1)

APPENDIX 1

State-wise list of 43 books analysed by different teachers

Uttar Pradesh

1. High School Geometry by Puttu Lal and Anmolak Ram.

Rajasthan

1. Elementary Mathematics by Lakshmi Narain.
2. Nutan Anivarya Ganit by T.K.Dandia and B.V.Mathur(1959 edition)
4. Naveen Anivarya Ganit by D.P.Kaushik
5. Secondary compulsory Mathematics by Dr.M.Ray and H.S.Sharma..
6. Nutan Anivarya Ganit by T.K.Dania and B.V.Mathur(1962 edition).
7. Nutan Anivarya Ganit by T.K.Danid and B.V.Mathur(1962 edition).
8. Madhyamik Ganit by J.P.Paneya
9. Adhunik Secondary Mathematics by R.P.Jhanvar.

Bihar

1. Naveen Ankganit by K.K.Prasad and S.D.Giri.

Gujarat

1. Nutan Beejganit by O.P.Jha, Bh.Ch.Bhatt,and V.L.Antani.
2. Arvachin Bhumiti by D.M.Desai and G.D.M.Parikh.
3. Ankganit by N.M.Shah and M.P.Vaidya.
4. Saral Madhyamik Bhumiti(St.VIII and IX) by N.M.Shah and R.M.Desai.
5. Saral Madhyamik Bhumiti (St.X and XI) by N.M.Shah and R.M. Desai.
6. Adhunik Beejganit (book 2)by D.C.Pavate and L.R.Desai.
7. Saral Madhyamik Beejganit by N.N.Desai.
8. Beejganit Pravesh (Pt.III) by N.M.Shah and C.M.Desai.

Andhra Pradesh

1. Saral Ganitham by M.K.Raghavacharyulu

Madras

1. Naveen Ganitham by R.S.Ram Chandra Iyyer.
2. Pothu Ganitham by M.Raja Iyar.

Mysore

1. Madhyamik Samanya Ganit by G.V.Dambal and V.V.Gadad
2. Jeevantha Ganit by N.Ramu and R.Lata Aiyanagar

Kerala

1. General Mathematics (IX standard)(Govt.of Kerala Publication).
2. General Mathematics (X standard)(Govt.of Kerala Publication).

West Bengal

1. Core Ganit by Keshab Ch.Nag.
2. Madhyamik Abashyik Ganit by Charu Ch.Chakravarti.

Assam

1. Ucha Madhyamik Saral Beejganit Pt.II by H.K.Bhattacharya
2. Arithmetic by R.K.Charkavarti.
3. Sahaj Beejganit by K.P.Basu

Punjab

1. Ganit Ki Naveen Pustak (The controller of printing and stationery,Punjab,Chandigarh).
2. University Matriculation Arithmetic.

Jammu and Kashmir

1. Elementary Mathematics by Raj Kumar
2. Elementary Mathematics(Core)by Raj Kumar.

Madhya Pradesh

1. Naveen Samanya Vigyan Avam Ganit (Bag 2) by S.P. Srivastava, D.C.Mailaya and L.C.Jain
2. Naveen Trikonmiti by R.S.Gupta
3. Saraswati Ankganit (Pt.I) by P.S.Kapoor.
4. Purva Madhyamik Ankganit by D.V.Sapre

Orissa

1. Prabeshika Beejganit Sopan by M.R.Ali,M.K.Ali and P.Das.
2. Madhyamik Nutan Parimiti by K.C.Mahanty and K.Maha Patra.
3. Madhyamik Saral Jyamiti by R.N.Mahanty,M.M.Nanda
4. Prabeshika Saral Jyamiti by Narain Pati and Nand Kishore Rath.

APPENDIX 2

Questionnaire for the Analysis of Textbooks in Elementary Mathematics.

A. General information

1) Title of the book ____________________

2) Class for which it is meant ____________________

3. Author's(s') name(s)	Author's(s') qualifications	Publisher's name and address
i.		
ii.		
iii.		
iv.		

4) (a) Number of pages ____________ (b) size of the page (in cms)

____________ (c) price ____________.

5) Quality of paper

☐ (a) White paper which is not likely to wear out easily.

☐ (b) White paper which is likely to wear out easily.

☐ (c) Yellowish paper which is not likely to wear out easily.

☐ (d) Yellowsish paper which is likely to wear out easily

☐ (e) Any other, please mention

____

____

6) Have you come across any printing errors? Yes/No

7) Please give an approximate number of printing errors ____________

8) Date of publication of the first edition ____________

9) Date of publication of the last edition ________________

10) Number of editions published ________________

11) Language in which the book was originally written. ________________

12) Name of the languages in which the book is translated ________________

13) Whether approved or recommended by some educational authority Yes/No

14) If yes, please give the name of that authority ________________

General Organisationof the textbooks

1) Does the book relate specifically to a syllabus? Yes/No

2) If yes, to which syllabus does it conform? ________________

2) Are all the topics in the syllabus covered in the textbook? Yes/No

If not, please mention the topic not covered in the textbook? ________________

____

____

3) Are there topics discussed in the book which are not in the syllabus Yes/No

If yes, please mention these topics ________________

____

____

4) Are you satisfied with the sequence of the topics given in the book? Yes/No

If not, what sequences would you suggest?

Arithmetic ________________

Algebra ________________

Geometry ________________

____

5) Do you have separate books for the different branches (e.g.Arithmetic,Algebra,Geometry) of the subject? Yes/No

If not, are these branches dealt in separate sections of the same books? Yes/No

If not, is the appraoch to the subject (Elementary Mathematics/General Mathematics) an integrated one? Yes/No

C. Subject matter

1) Please tick mark the following that are included in the present textbook.

a) Description in narrative form

b) Discussion in question answer form

c) Illustrative solved examples

d) Bractice exercises

e) Exercises for revision

f) Text papers

g) Question papers of Boards and Universities

h) Answers to the sums in exercises

i) Answers to the sums in question papers

j) Diagnostic texts

2) Does the book contain solved examples? Yes/No

If yes, do these clarify the concepts? Yes/No

3) Can a bright student study the subject on his own? Yes/No

4) Do the sums in Exercises provide for individual differences in abilities?

☐ a) Yes

☐ b) To xome extent

☐ c) No

5) Does the book contain exercises for revision? Yes/No

6) If so, at what place are these exercises for revision given in the book?

☐ a) At the end of each chapter

☐ b) At the end of each topic

☐ c) After all the topics are covered

d) Any other, please specify.

7) Does the book contain any question papers(question-papers of Boards or Universities only)? Yes/No

8) Does the book contain any test papers? Yes/No

9) If so, at what place are these test papers given in the book?

☐ a) At the end of each chapter

☐ b) At the end of each topic

☐ c) After all the topics are covered.

d) Any other, please specify_______

10) Are answers to all the exercises given? Yes/No

11) Does the book contain problems from day to day real life situation?

☐ a) Yes, quite a number of them.

☐ b) Yes a few.

☐ c) No.

12) Have you found any absurdity regarding problems? Please illustrate.

13) Have you come across a large number of errors in exercises?(Please mention about the errors in respect of the subject matter only). Yes/No.

Give an approximate number of errors you have come across __________

14) Are the sub-topics(within a topic)developed in a sequential order? Yes/No

15) Are the sums in'Exercises'grades from simple to comples Yes/No

16) Are there suggestions given for experimental work? Yes/No

17) Are there any unnecessary lengthy calculations required for solving the sums?

☐ a) Yes, for many sums.

☐ b) Yes,for a few sums

☐ c) No.

18) Which units of measurement are used in the discussion and the sums?

☐ a) British

☐ b) Metric

☐ c) Both

D. Style of writing

1) Is the language used within the comprehension level of an average student?

☐ a) Yes.

b) Yes, barring a few exceptions

☐ c) No.

2. What are the methods used for explaining the concepts?

☐ a) Discussion-posing a question and then answering

☐ b) Description-direct narration

☐ c) Solved examples-by giving practical examples

☐ d)

☐ e) Any other, pleasemention

(Check one or more alternatives as applicable in your case)

3. Are the new terms in a topic defined in a clear and exact manner? Yes/No

4. Are the concepts in a topic explained in a clear and definite manner? Yes/No

5. Are the principles involved in a topic discussed in all possible manipulative forms? Yes/No

E. Pictorial or graphic illustrations

1. Are the pictorial and graphic illustrationa adequate

☐ a) More than required

☐ b) Adequate

☐ c) Inadequate

2) Are the pictorial and graphic illustrations accurate? Yes/No

3) How do the pictorial and graphic illustrations contribute to the understanding of the subject?

F. Objectives

1) Are the objectives of writing the book stated in the preface? Yes/No

2) Does the treatment of the subject in the book help the achievement of the objectives stated in the preface?

☐ a) Yes

☐ b) To some extent

☐ c)

3) Are the objectives specified in the syllabus achieved in the treatment of the subject in the book?

☐ a) Yes

☐ b) To some extent

☐ c) No

G. Miscellaneous

1. Are the textbooks of the same author(s) used in different grades of your school? Yes/No

In what grades are these books used? (please mention)

____

____

____

If so, please state how the continuity of the topics covered is maintained from grade to grade in all the books.

____

____

____

2) Which of the following things would you like to include in the present textbook?

a) Practical problems from day to day life situation

b) Mathematical tables

c) Topic-wise tests

d) Term test papers

e) Chapter wise summary giving terms and principals involved.

f) Concept-wise practice items

g) More sums for drilling

h) Any other, please mention.

____

____

3) Please give your considered opinion regarding the book in a few paragraphs.

APPENDIX 3

a) List of books analysed for sources of problems

1. Secondary Anivarya Ganit by Ray and Sharma.
2. Navin Anivarya Ganit by D.P.Kaushik.
3. Navin Saral Ganit by Anand Swarup Sinha.
4. Anivarya Ganit by Dr.Mahesh and others.
5. Saral High School Ankganit by Ray and Sharma
6. Subodh Madhyamik Ganit by Dandia and Sindhavi
7. Uttar Pradesh High School Ankganit by Tej Ram and Pitambar Lal.
8. Saral Anivarya Ganit by Goyal and Gupta.
9. Parambhik Ganit by Ram Sahai Verma &Ishwar Lal Verma
10. Subodh Ankganit by Ram Shanker.
11. Ganit Ratnakar by Chaturvedi,Sharma &Agarwal.
12. Nutan Higher Secondary Ganit by Dandia and Mathur.
13. High School Ankganit by R.V.Sharma
14. New Light Arithmetic by Kapoor and Gupta
15. Golden Arithmetic by Saxena and Garg.
16. Saral School Ankganit by F.C.Rastogi.
17. Ankganit by J.C.Chakravarti.
18. Navin Ganit by Sankhyadhar and Bhadauria
19. Navin Anivarya Ankganit by Ramakant Chaturvedi &Others.
20. Navin Samanya Vigyan Avam Ganit by S.P.Srivastava &Others.
21. Navin Ganit by Desh Raj Jain & Ram Lal Gupta
22. New Era Arithmetic by Vishva Nath and T.C.Gupta
23. Sawhney's Higher Arithmetics by R.C.Sharma and I.S.Khosla.
24. Madhyamik Ganit by J.P.Pandeya.
25. Saral High School Beejganit by Ray and Sharma.
26. Adhunik Beejganit by Bhadra Gupta.
27. Ankganit Darpan by J.P.Rastogi.
28. Uchatar Madhyamik Beejganit by Inamdar.

(b) Categories of sources of problems used in textbooks.

A.Personal Life and Family Life.	1.Age; 2.Height; 3.Attendence; 4.Weight; 5.Working capacity;6.Food; 7.Income, expenditures and savings;8.Marks secured in examinations; 9.Examination results; 10. Deaths; 11.Wages of workers; 12. Spending leisure time.
B.Industry	1.Incomes; 2.Savings; 3 Production; 4.Expenditures; 5.Machineries and their values; 6. Industrial losses
C.Agriculture	1.Production; 2. Areas of fields; 3.Working in fields(ploughing,reaping crops etc.); 4.Planting; 5.Irrigation.
D.Transport	1.Traffic load; 2.Laying out railway lines; 3.Constructing bridges, roads etc.; 4.Speed of means of transport; 5.Transportation charges.
E. Business	1.Buying and selling; 2.Banking; 3.Taxes; 4.Imports and Exports; 5.Shares; 6.Insurance; 7.Discounts; 8.Foreign exchange
F.Other Subjects.	1.Physics; 2.Chemistry ; 3.Geography; 4.Economics; 5.Drawing
G.Weather	1.Temperature; 2.Rainfall; 3.Time Zones; 4.Humidity; 5.Weather graphs
H.Miscellaneous	1.Mixture; 2.Population and gangs; 3.Shadows of towers, trees etc.; 4.Capacities of containers; 5.Games and sports; 6.Contributions; 7.Taps and cisters; 8.Speed of animals, streams, air etc.; 9.Elections; 10.Areas and volumes of solids and hallows; 11.Fractions; 12.Comparison of different things.

(c) Charts showing the number of problems for each category

Topic: 1. Four simple rules

Category/No.of Books	1	2	3	4	5	6	7
A.	1	1	2	19	7	0	5
B.	0	0	0	0	0	0	0
C.	0	1	0	0	0	0	0
D.	0	0	2	5	2	0	2
E.	1	1	2	5	2	0	2
F.	0	0	0	0	0	0	0
G.	0	0 9	0	0	0	0	0
H	0	0	0	0	0	0	0
Total sums in the book	110	96	100	100	313	302	391

......2/....

Topic: 2. Ratio and Proportion

Category/No.of Books	1	2	3	4	5	6	7	8	9	10	11	12	13
A.	23	15	18	3	13	2	62	31	9	10	10	3	20
B.	0	0	0	0	0	0	0	0	0	0	0	0	0
C.	4	0	5	0	0	0	4	0	0	0	2	0	1
D.	6	7	9	3	6	0	21	14	2	5	3	1	4
E.	1	0	0	0	1	0	0	1	0	2	1	0	2
F.	0	0	0	0	0	0	0	0	0	0	0	0	0
G.	1	1	1	0	0	0	0	0	0	0	0	0	0
H.	6	2	6	0	2	0	1	6	0	8	1	0	0
Total sums in the book	109	113	195	29	97	69	173	142	90	70	55	76	61

......3/......

Topic: 3. EQUATIONS

Category/No.of Books	1	2	3	4	5	6	7	8	9	10
A.	19	19	31	17	10	26	3	22	41	21
B.	0	0	0	0	0	0	0	0	0	0
C.	0	0	0	0	0	0	0	0	0	0
D.	12	1	6	0	0	1	0	1	18	10
E.	6	11	31	21	5	16	2	16	17	11
F.	0	0	0	0	0	0	0	0	0	0
G.	0	0	0	0	0	0	0	0	0	0
H.	2	10	8	10	7	3	3	5	28	20
Total sums in the book.	139	106	166	159	103	112	16	67	171	114

Topic: 4.PERCENTAGE

Category/No.of Books	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	8	7	10	8	8	4	5	10	8	15	4	6	0	5	4
B.	0	0	0	0	0	0	1	0	0	0	1	0	0	4	0
C.	1	0	0	0	1	0	3	0	3	0	0	0	0	0	0
D.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E.	20	18	18	10	18	19	13	31	19	12	13	19	7	21	31
F.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H.	21	24	17	24	17	24	24	16	27	16	6	15	3	32	6
Total sums in the book	61	72	174	43	54	60	73	69	77	59	53	49	16	63	72

Topic: 5. Graphs

Category/No. of Books	1	2	3	4	5	6	7	8	9	10	11	12	13
A.	6	2	3	10	6	4	4	4	5	0	1	5	6
B.	9	13	1	3	1	1	9	4	8	2	3	9	1
C.	1	0	1	0	1	0	3	0	3	0	0	3	1
D.	0	0	0	1	1	1	2	0	0	0	0	0	1
E.	2	4	4	3	2	2	8	3	6	1	2	5	2
F.	1	0	1	0	0	0	0	1	0	0	0	0	0
G.	10	13	8	3	13	9	1	7	3	6	6	3	13
H.	8	7	5	11	6	4	3	6	6	6	2	5	6
Total sums in the book	43	43	28	44	39	26	36	31	35	17	15	33	42

PTO

Topic 6.

AVERAGE

Category/No. of Books	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	28	23	15	18	33	15	38	25	14	16	23	23	10	29	29
B.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C.	4	0	0	0	1	0	0	0	0	0	0	1	0	0	0
D.	0	6	2	0	2	2	5	0	1	0	1	2	1	1	3
E.	3	2	4	1	4	3	4	1	0	2	2	2	2	3	4
F.	0	0	0	0	0	0	0	0	0	0	0	0	0		
G.	2	5	3	3	3	2	2	4	4	1	4	1	1	3	2
H.	1	4	3	2	3	3	4	5	5	2	2	3	1	6	6
Total sums in the book.	46	42	42	25	55	34	67	36	36	31	37	41	20	42	49

PTO

Topic: 7. TIME AND WORK

Category/No. of Books	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	4	4	2	4	2	2	0	3	1	1	0	0	4	0	1
B.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C.	16	3	5	3	4	1	1	4	0	3	5	3	2	0	3
D.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
E.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H.	0	0	0	0	0	0	0	18	27	9	0	0	0	13	16
Total sums in the book.	39	45	51	36	71	73	64	76	76	32	33	48	87	54	69

PTO

Topic: 8. WORK AND WAGES

Category/No. of Books.	1	2	3	4	5	6	7	8	9	10	11	12
A.	0	0	0	1	0	0	2	2	0	1	0	0
B.	0	0	0	0	0	0	0	0	0	0	0	0
C.	0	1	0	1	2	0	0	1	0	1	0	0
D.	0	0	0	0	1	0	0	0	0	0	0	0
E.	0	0	0	0	0	0	0	0	0	0	0	0
F.	0	0	0	0	0	0	0	0	0	0	0	0
G.	0	0	0	0	0	0	0	0	0	0	0	0
H.	0	0	0	0	0	0	0	0	0	0	0	0
Total sums in the book.	23	16	13	14	16	12	12	20	9	10	6	9

Topic: 9. TIME AND DISTANCE

Category/No. of Books	1	2	3	4	5	6	7	8	9	10	11	12	13
A.	16	27	20	20	15	31	13	13	49	35	13	27	21
B.	0	0	0	0	0	0	0	0	0	0	0	0	0
C.	0	0	0	0	0	0	0	0	0	0	0	0	0
D.	10	6	8	7	10	5	9	45	39	10	9	25	11
E.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.	0	0	0	0	0	0	0	0	0	0	0	0	0
G.	0	0	0	0	0	0	0	0	0	0	0	0	0
H.	3	3	0	2	6	9	0	17	18	7	2	13	2
Total sums in the book	30	36	32	35	34	48	31	76	108	54	24	65	36

CURRICULUM AND TEACHING OF MATHEMATICS
IN THE
HIGHER SECONDARY SCHOOLS

A STUDY OF TEACHING LEARNING PRACTICES IN MATHEMATICS

MONOGRAM

NIE - HEW - 009
Department of Curriculum and Evaluation
(National Council of Educational Research & Training)
NIE Campus, Mehrauli Road, New Delhi-16.

CONTENTS

Introduction 1

Teacher 8

Class Size 12

Section I

Motivation 15

Linking the present lesson with the previous one 16

Teaching new concepts 17

Problem - solving 20

Individual and group work 26

Home-work 30

Teaching - aid 37

Section II

Questions 1-24 44

Appendix I

Appendix II 87

Appendix III 93

Appendix IV 100

Appendix V 103

Appendix VI 104

Appendix VII 105

INTRODUCTION

This brief report is an analysis of a limited survey of 30 schools selected from four States, viz. Bihar, Gujarat, Mysore and Punjab, and the Union Territory of Delhi. The purpose of this study was to know as many as possible of current teaching-learning practices followed by teachers and students in the study of Elementary Mathematics (the minimum compulsory course). This was considered to be an essential pre-requisite to the actual development of the curriculum for General Mathematics as proposed in the project.

Schools in individual States and the Union Territory were so selected as to cover urban and rural schools and a fair distribution of boys' and girls' schools. Care was also taken to include both Government and non-government schools. As no comparative analysis was intended, this selec- of schools was not based on any sampling techniques. In this coverage five languages (used as medium of instruction), viz. Hindi, Gujarati, Kannada, Punjabi and English were involved. This necessitated seeking cooperation from persons from outside the project staff. In order to avoid individual biases to the extent possible the cooperating investigators were oriented to the tools employed and one member of the project staff was associated with every cooperating investigator.

For each school one class (or section) was taken up but in three cases two classes were also observed. Thus, whereas the number of schools visited was 39 (Appendix I) the number of classes observed was 42.

Tools

The tools used for this study were

i) A questionnaire for students

ii) Observation of classroom teaching

iii) Interview with teachers

iv) Interview with students in groups.

v) List of points for study of students' class and home-work note-books (a sample of ten note-books of each type for each class).

vi) General information blank.

Development and Description of the tools

This first draft of the questionnaire for students was prepared in Gujarati and tried on about 100 students in Gujarat. After the tryout a modified version was prepared in English and translated into Hindi. This was further modified after using it in two schools in Bihar, though the structure or basic questions of the original was not changed in any way. This version was used for the whole study and Gujarati and Kannada versions were also prepared on the basis of this final form. A large majority of the questions had a number of responses listed along with and every respondent was required to mark one of the responses that applied to him. A few cases of non-compliance of instructions were, however, observed. In addition, there were a number of open-ended questions, too. These questions were kept open-ended purposely because pre-listed responses were likely to vitiate results otherwise expected. For example, a question like 'With what purpose in view do you study Elementary Mathematics?' would not elicit a correct response if the same were listed in the questionnaire, for them the students would select the socially best accepted response. The respondents, at times, did need some help to understand the implications of some questions here or there. The investigators were given clear instructions on how far they could go by way of explaining the questions and at the same time avoiding any suggestions.

The respondents were questioned on a number of activities connected with the study of Mathematics. (Questionnaire: Appendix II). To clarify the instructions the investigators were asked to read out the instructions to the students and explain them. One practice item was also to be done under the supervision of the investigator so as to ensure understanding and proper compliance. This was useful for establishing a healthy rempart between the investigator and the respondents and the strain of sitting of sitting for about three hours was not very heavy.

In order to know the teaching techniques followed by different teachers the investigators were required to sit in a class for a full period and record every activity of the teacher and the students in time periods of 3 minutes. This was expected to be a faithful record of what was done in the class, free of any personal bias of the investigator. This record was later analysed on a five-point scale over seven important elements of a lesson. (Appendix III). These items were first listed and then sent to 15 Mathematics teachers for comments. Items selected finally were put on a five-point scale for the rating of every teacher.

The schools had information in advance regarding the visit of the research staff. They had been advised not to take the visit as a formal activity but to conduct the school programme so as to present the actual position in its day-to-day settings. In majority of the cases investigators felt that not much formality was observed.

But seeing a teacher in one period is not likely to give complete picture of his work. This handicap was thought to be compensated through an interview with the teacher. Care was taken that interview with the teacher never precdded classroom observation. This restriction had to be imposed because some of the questions in the interview were likely to caution the teacher regarding his teaching techniques and could have acted as a suggestion to be formal. The teacher's interview was not a completely structured one. The investigator had the purposes of teacher's interview with him and also the guiding points for the interview (Appendix IV). To that extent the interview could be termed as structured. But at points the investigator had to get information through oblique references to points where some camouflaging was suspected. This probing was not only permitted but was encouraged also. At the end, the investigator would ask the teacher if he had any comments to make. These were also recorded. Throughout this conversation the investigator was assisted by a recorder who recorded almost verbatim the questions and replies to them for analysis at a later date.

As it was quite likely for some teachers to present a very bright picture of themselves, it was considered to be helpful to have a cross section of the student group and their narration of the teaching method. For this purpose was introduced another tool - Students' Group Interview.

The selection of students for this group interview was first tried on a random-sampling technique. Every student had a serial number corresponding to him in the attendance register. Using a table of random numbers eight students were sampled out for the purpose of interview. A difficulty observed in this technique was that at times not much of an information could be obtained from students so selected. Then it was tried and one or two students responding quickly to the questionnaire were included in the group. In co-educational classes at least two girl

3

students were included. After talking to these students about the purpose of the visit and the project the investigator would ask them to narrate in as detailed a form as possible, the progress of the last lesson, in Arithmetic if the lesson observed was in Arithmetic. As a demonstration the investigator would narrate the day's lesson for about two or three minutes so as to give them an idea of the narration. The need for a factual narration was impressed upon them. The investigator, at intervals, had to intervene to keep the narration continuous and relevant. If any significant point was found missing, after students' narration the investigator asked questions to elicit further information

Similar narrations for last lessons in Algebra, Geometry and other branches were asked for. The recency of the last lesson was an important factor affecting the completeness of the narration. Throughout the group interview a recorder recorded the conversation between the investigator and the group. Here, again, the general purposes (Appendix V) of the group interview were to be kept in mind by the investigator. Otherwise, the interview would have been a narration by the students intermittently interrupted by the investigator's probing questions. In the end the students also were asked to comment on Mathematics Education. This technique of group interview involved an inherent difficulty of students eulogizing a teacher otherwise feared. At times, if a student came out with some information which the others resented, they would throw hints to him not to do so.

Although teacher's interview and students' group interview helped in getting a good deal of information on the teaching techniques and some on written work, it was found that more reliable sources of information on the latter could be home-work and class-work note-books. Ten note-books of each type were collected and studied for regularity of assignments and checking, quality of checking, homogeneity or otherwise of assignments, etc. These points are appended in Appendix VI. All the information collected through the above tools concerned only one class or section, and the teacher who taught it. But some knowledge of the student strength and those offering mathematics, along with the results in the final examination could help to see the class from a broader perspective. For this purpose information was collected in a simple form (Appendix VII).

Timing of the Study

Field work for this part of the project started in February 1964 when the draft questionnaire in Gujarati was administered to about 100 students in Gujarat. This was preliminary work and the responses given by the students though used for modifying the questionnaire are not included in the final analysis. Schools in Bihar (seven in all) were studied in March 1964. The academic session there starts in January and the students had by then gone through about two months of schooling. In Delhi two schools (three classes) were visited in March 1964 and the remaining six in September. Eight schools from Punjab were studied in May-June 1964 and Gujarat and Mysore (eight schools in each of the two States) were covered in July 1964

These timings also affected the study in certain ways. In one instance the year's course had been completed and revision work was being done. In another case the class visited was meeting the teacher for the first time. In another (a small school in a mofussil town) the regular mathematics teacher had gone to attend the Summer Institute for Mathematics teachers. In still another (a rural school) the teacher had joined a week earlier and before that there was no teacher who could teach Mathematics. All these factors contributed in their own way. The earlier days of an academic session caused certain difficulties of student groupings, staff appointments, etc.

Coming to an individual school it took the project staff about four hours to complete the whole work for one group. Distribution of time for one group is as under:

	Tool	Time taken
1.	Classroom observation	30 mts. to 50 mts. (depending on the duration of the period)
2.	Questionnaire	50 mts. to 75 mts.
3.	Teacher's interview	30 mts. to 45 mts.
4.	Students' group interview	30 mts. to 60 mts.
5.	Class and home-work note-books	about 30 mts.
6.	General information	about 30 mts.

Though this was the time taken for individual items the total time to be spent in schools came to about four and a half hours and in individual cases to about six hours.

Teacher - Qualificatidn and Experience

The teacher occupies the central place in classroom teaching, for the controls and guides all the learning experiences. Much of the effectiveness of the teaching-learning situation depends upon the professional preparedness and interest of the teacher. Many important aspects of teacher preparedness and personality make up his quality of teaching. With this in view an attempt was made to know from teachers their qualifications, experience, their likes or dislikes for subject, etc. The information obtained in interviews with teachers in various states is presented here.

State	No. of teachers interviewed	Qualifications			Experience in Teaching in(years)	Qualification in Maths.	Remarks
		Subject	Education Training	No. of teachers			
Bihar	8	M.Sc. (Chem)	Dip. Edu.	1	15 Nil	B.Sc. B.Sc.	2 teachers did not like to teach Math but were forced to teach it.
		M.Sc. (Phy.)		1			
		BA/B.Sc.	Dip.	2	15,22	BA/B.Sc.	11 teacher was not interested in teaching at all.
		BA/B.Sc.	Edu.	2	5,11	BA/B.Sc.	
		BA	S.T.C.	1	23	BA	Others were silent on the issue.
		Inter Arts	½ yr. Trg.	1	26	Inter	
Gujarat	8	B.Sc.	B.Ed.	2	9,7,10,12	B.Sc.	2 teachers indicated preference to teaching Maths.
		B.Sc.	S.T.C.	2			
		B.Sc.	LL.B.	1	18	Inter	Others were silent on the issue
		B.Sc.		3	Nil,5,5	Inter, B.Sc.	

State	No. of teachers interviewed	Qualifications			Experience in Teaching in (years)	Qualification in Maths.	Remarks
		Subject	Education Training	No. of teachers			
Mysore	8	B.Sc.	B.Ed.	7	1,3,3,10, 15,15,18	B.Sc.	7 teachers gave preference to teaching maths. One gave his preference to teaching chemistry
		B.Sc. (Hons)	B.Ed.	1	18		
Punjab	10	M.A.	B.T.	1	11	Inter	One of the teachers was in a leave arrangement.
		M.A.		1	1	B.A.	
		B.A.	B.T.	6	37,11,24, 2½,10,nil	Inter B.A.	All the teachers questioned gave their preference to teaching Mathematics.
		B.Sc.		1	Nil	High School B.A., B.A., B.A., B.Sc.	
Delhi	9	M.Sc.	B.T.	1	6	M.Sc.	Not at all the classes observed were elementary Maths. classes. This might have affected the qualifications. All but one were interested in teaching Mathematics.
		MA/M.Sc.		4	2,9,7,5½	M.A.	
		B.A./B.Sc.	B.T.	4	6,9,19, 4.	B.A.	

The wide variety in the qualification of teachers and their experiences is evident from the above table. Delhi and Mysore have teachers of the same qualifications in subject and nearly all teachers are trained. The picture is not so encouraging in the other states where most teachers are either undergraduates or untrained. Presuming that adequate knowledge of the subject is prerequisite to self-confidence of the teacher, the indifference to the teaching of Mathematics of the most of the teachers in States, other than Mysore and Delhi, is quite understandable.

Another factor which relates to teacher competence is his awareness to the objectives of teaching mathematics. The selection of method and learning experiences very much depend upon the objectives that the teacher accepts for teaching the subject. It was therefore thought desirable to question teachers as to what according to them would be the objectives of teaching mathematics. The teachers were free to mention as many objectives as they thought necessary. Most of the teachers were found to be quite indifferent towards the issue and were naturally not clear about the objectives.

The list of objectives mentioned by the teachers and the frequency indicating the number of teachers who mentioned them is given below:

	Objective	Frequency
1.	Knowledge	17
2.	Thinking power and/or reasoning	13
3.	Use in daily life and higher studies	8
4.	Application of knowledge	7
5.	Development of skills	7
6.	Accuracy/exactness/precision	5
7.	Preparation for examination and better results.	5
8.	Quick calculation	2
9.	Preparation for practical life	2
10.	Systematic work habits	1
11.	Learning patience	1
12.	Day-to-day problem-solving ability	1
13.	Subject as a part of life and miror of civilization.	1

	Objective,	Frequency
14.	To be able to manage one's things	1
15.	Mathematical interest and hobbies	1
16.	As it is in the syllabus	1
17.	Development of memory	1
18.	Mental exercise	1
19.	Systematic generalization	1

CLASS SIZE

Teacher effectiveness in the class very much depends upon the size of the class as well. Classes vary in sizes in the same state and also from one state to another. Since, it is not possible to discuss the individual class variations in this limited study, the averages for each state have been worked out as below:

State of Union Territory	Total No. of students observed	Total No. of classes or sections	Average strength in a class	Minimum strength in a class	Maximum strength in a class
Bihar	374	8	46.75	28	76
Gujarat	363	8	45.38	38	58
Mysore	366	8	45.75	38	58
Punjab	266	8	33.25	9	57
Delhi	242	9	28.89	15	51

The table above shows a wide range of variation in class strength in Bihar, Punjab and Delhi. In Gujarat and Mysore the range is not so wide. It may be so because in Mysore, General Mathematics is among the compulsory group of subjects and no other option is given and in Gujarat students can select any two subjects from amongst the three - Social Studies, General Science and Elementary Mathematics, and option is provided only to students appearing from Technical Schools or High Schools for Commerce. Therefore, most students in Mysore and Gujarat offer Mathematics as a compulsory subject. The lowest strength (9) was in a rural school for girls in Punjab where a number of girls did Arithmetical problems as part of household management. The lowest strength (15) in a Delhi rural school was attributed to the existence of two or three other higher secondary schools in the same area. The highest strength (76) in a school from Bihar was attributed to teacher shortage, which necessitated combining three sections. These problems are not directly related to the curriculum but do influence the over-all learning possibilities.

An analysis of teaching-learning procedures is not a simple task. Learning is a complex process and takes place through many avenues. Also, each teacher plans his teaching in a way that suits his pupils. Moreover, it is difficult to analyse various phases or stages of learning either. What is, therefore, presented here in Section I is a factual record of what was observed in classes by the investigators, and reported by teachers and students during the interview. To systematize the information, it has been organized into seven important elements of a typical mathematics lesson: motivating the children, linking the present lesson with previous one, teaching new material, problems-solving, individual and group-work, home-work and use of teaching aids. A few of these elements such as problem-solving, home-work, teaching aids, have been further sub-divided. Each element and the sub-divisions have been rated on a five-point scale (See Appendix III).

Section II gives a question-wise analysis of the questionnaire which the students were asked to fill in. Wherever possible significant figures for different States and for city and mofussil areas in each State have been given to facilitate some sort of comparison.

Section 1
(Teaching - Learning procedures)

I. MOTIVATION

The importance of proper motivation for a lesson need hardly be stressed. Effective learning takes place when pupils are interested in the lesson. What we are considering here is the conscious effort on the part of the teacher to secure pupil interest and attention. In most of the lessons observed the teacher, it appeared, did not bother about motivation. Soon after entering the class the teacher, in most cases, began with a statement like the following:

'Last time we did ...., today we are going to study.................................... Each lesson was planned as a logical successor to the previous lesson. A few teachers reprimanded those who did not attend while a few others encouraged some pupils.

The forty-two lessons observed are rated as follows:

	Category	Frequency
1.	Is indiferent about motivation	23
2.	Always reprimands	6
3.	Encourages good students only	1
4.	Encourages the weak students only	5
5.	Reprimands and encourages as and when required	7

II. LINKING THE PRESENT LESSON WITH THE PREVIOUS ONE

Mathematics is a sequential subject. The learning of new concepts or skills in any lesson depends upon the concepts and skills already learnt. Also, unless a mathematical concept is related to other phases of already learnt mathematics, much time will be wasted in securing the interest of the pupils. Therefore, before beginning the day's lesson, it becomes incumbent on the teacher to find out as much as he can about the students' background with reference to such abilities and information as will be required in the new work.

Out of the lessons observed, 40 lessons required some linking up with previous lessons. These are rates as follows:

Category	Frequency
1. Just starts the new lesson	17
2. Simply asks, 'What did we do last time?'	6
3. Asks about difficulties in the problems assigned for home-work.	2
4. Revises some of the connected concepts through oral questioning.	9
5. Discusses all the connected concepts	6

This issue was also reported by students in their group interview. Of 26 teachers, students did not mention anything about the linking of the present lesson with previous one. Most probably these teachers just start with the new lesson. Students, however, did mention this in connection with 14 remaining teachers. They are rated as follows:

Category (as above)	1	2	3	4	5
Frequency		4	2	6	2

An important fact that emerges out of students' responses is that out of the 14 teachers who linked their lessons with previous ones only one teacher had linked a Geometry lesson. Most of the geometry lessons start almost independently.

III. TEACHING NEW CONCEPTS

a) Introducing new concepts

A foremost problem of instruction in secondary school mathematics is the teaching of new material. There is no single method of introducing a new concept, principle, relationship or skill. The primary jobs of a teacher are to explain, to make clear, to enable the pupils to discover, to develop understanding, etc. The effectiveness of the lesson depends very much upon the degree of participation that the teacher receives from his pupils in the unfolding of the unfamiliar material.

Out of the 42 lessons observed, 32 lessons were on the teaching of new subject-matter. These are rated as follows:

	Category	Frequency
1.	Teacher simply defines the new terms	6
2.	Teacher explains but the explanation is not systematic.	6
3.	Teacher explains systematically	12
4.	Teacher develops new concepts with the help of the pupils.	6
5.	Teacher helps the pupils discover new concepts.	2

During the group interview also, the students were asked to give information on how their teachers introduced new materials. The information was obtained separately for Arithmetic, Geometry and Algebra.

In Arithmetic and Algebra information could be obtained in respect of 18 teachers. In Geometry similar information was made available for 26 teachers. These are rated as follows:

Category	No. of lessons in Arithmetic	Algebra	Geometry	Total
1. Simply defines the new concept	3	2	-	5
2. Explains but the explanation is not systematic	4	3	5	12
3. Explains the concept systematically	10	10	17	37
4. Develops the new concept with pupil participation	1	3	4	8
5. Helps the pupils discover new concepts.	-	-	-	-

It comes out of this analysis that the pupils themselves feel that at least in 90% cases the teacher does not seek their participation and does most of the talking himself. Also, the explanations given by teachers are systematic more in Geometry than in Arithmetic or Algebra, which might be due to the fact that most of the steps in Geometry are logically arranged and the teacher follows them in sequence.

(b) Ensuring learning of new concepts

Teaching new materials, the teacher should also ensure that proper learning has taken place. Even when a teacher tries his best procedures, it is possible that they have resulted in superficial learning or no learning at all. Many difficulties in mathematics learning can be traced to the imperfect learning of new materials.

Out of the 32 teachers who taught new concepts, 7 did not bother about finding out if pupils understood; 8 simply asked them if they had understood; 12 teachers tried to ensure it through oral work and 4 teachers through written work. Only 1 teacher used both oral and written work to ensure learning.

If we put the category-wise frequencies for teaching new materials (as obtained in 'a' above) against the above frequences, we find a great similarity in the pattern.

Category	No. of lessons under Teaching new concepts	No. of lessons under Ensuring learning of new concepts
6 1	6	7
2	6	8
3	12	12
4	6	4
5	2	1
	32	32

Not much information on this aspect could be obtained from group interviews of students as it was found rather difficult to explain it to them in a non-suggestive manner. It was only for 10 teachers that information was available. Out of these 10 teachers 1 did not bother, 4 just asked the pupils if they had understood, 4 tried to ensure it through oral work and 1 did it through written work.

IV. PROBLEM-SOLVING

An important objective of teaching mathematics is to increase the child's ability to think with the ideas of mathematics. This makes problem-solving a major concern of the mathematics teacher. Problem-solving is used both as a method and as content. Much has been said and written on the definition of problem and problem-solving. For the purpose of this study we took the same meaning of 'problem' as is popular in common parlance, viz., a problem is any challenging question proposed by the teacher (or students) for solution in the class, and gave consideration to the following aspects in problem-solving.

a) Selection of the problem
b) Presentation of the problem
c) Ensuring understanding of the problem
d) Analysis of the problem
e) Solution of the problem
f) Drill on typical difficulties in solving the problem
g) Practice on similar problems.

a) Selection of the Problem: Problem-solving begins with the child's acceptance of the problem. Unless the problem is within the range of his experience, he may not feel the need to solve it and may develop a wrong attitude towards it.

Out of the 37 lessons in which teachers solved problems only 35 lessons required some selection of the problem. These are rated as follows:

Category	Frequency
1. Does not make any selection but follows the exact order of problems as given in the textbook.	11

Category	Frequency
2. Selects only suitable problems and from the textbook and does not follow the exact order of problems.	13
3. Selects suitable problems from other sources but they are not real to the students.	4
4. Selects suitable and real problems from other sources.	5
5. Formulates suitable and real problems.	1

This shows that to a great extent teachers depend upon the textbooks for the selection of the problem. This is apt to make the subject monotonous and devoid of reality and genuineness.

When asked about the use of materials other than the textbook to supplement their teaching, 19 teachers admitted the use of other materials. Of these 19 teachers, 4 used question papers from previous examinations after they had finished regular teaching, the other 15 used other textbooks (not prescribed for the class), reference books and question papers from previous examinations.

b) Presentation of the problem

The importance of making children understand the problem before proceeding to solving it cannot be denied. Much of the child's understanding of the problem depends upon the manner the teacher presents it. The quality of presentation depends upon the opportunity it gives to children to read the problem, and see its relationships to past experiences. There is no one way of presenting a problem. The 37 lessons observed in this connection show that teachers followed different techniques. These are rated as follows:

	Category	Frequency
1.	Reads out the problem to the class	12
2.	Asks the class to read the problem silently from the textbook.	4
3.	Asks a couple of students to read the problem aloud.	-
4.	Reads out the problem and writes excerpts on the black-board as well.	6
5.	Writes the full statement of the problem on the black-board and reads it aloud too.	15

The number of teachers under category 5 includes the treatment of such lessons in Algebra and Trigonometry where writing the full statement of the problem was only writing a symbolic statement.

c) Analysis of the problem

After the problem has been presented the teacher is expected to enable the students to systematically analyse it by requiring him to go through a sequence of steps, such as what is required? What is given? what operations can be used? etc. It requires recognition of relationships and getting the meaning of the problem.

The 37 teachers observed are rated as follows:

Category	Frequency
1. Does not analyse the problem at all	6
2. Does not analyse the problem systematically	7
3. Presents a systematic analysis of the problem	11
4. Presents a systematic analysis of the problem, at times putting suggestive questions	9
5. Analyses the problem systematically with full participation of the students.	4

d) Ensuring understanding of the problem.

A teacher has now to ensure that the students have understood the problem. If there is any lack of understanding then the teacher has to trace the above stages again. The 37 teachers observed in this study are rated as follows:

Category	Frequency
1. Does not bother about students' understanding	6
2. Just asks them if they have understood	11
3. Asks some selected students	11
4. Asks some students and repeats the analysis, if necessary	5
5. Ensures understanding by almost all	4

e) Solution of the problem

The solution of problem requires higher mental activity than that involved in sheer computation. It is difficult to say which method is best for solving problems. A wise teacher at each step helps each student to work out a solution for himself and does not insist on a single method.

The 37 teachers observed in this study were rated as follows:

	Category	Frequency
1.	Does not solve the problem at all	-
2.	Presents the full solution of a new problem	3
3.	Solves the problem without student participation	10
4.	Solves the problem with student participation	23
5.	Discusses all possible methods of solving the problem.	1

f) Drill on typical difficulties of the problem

A problem is solved by each individual student in his own way and in so doing he had to coordinate a number of skills. The causes of failure in problem-solving are many and each child has his own area of difficulty. Some difficulties are individual and some are common for many students. The various steps through which a student passes in solving problems, are not mutually exclusive and weakness in one skill may lead to failure in some other. It is, therefore, important that the teacher should locate typical difficulties of the students and give them sufficient practice in that area to each individual student.

The 37 teachers observed in this study are rated as follows:

	Category	Frequency
1.	Does not bother about typical difficulties	18
2.	Simply tells the students typical difficulties of the problem	6
3.	Suggests some drill work on typical difficulties	11
4.	Gives them drill in class but does not look into individual difficulties	-
5.	Gives them drill and looks into individual needs.	1

g) Practice on similar problems

In mathematics it is necessary to perfect and maintain skills through systematic practice on similar problems. This also gives students more confidence in the use of skills whenever occasion demands.

The 37 teachers observed in the study are rated as follows:

	Category	Frequency
1.	Does not give any practice on similar problems	6
2.	Gives general hints for solving similar problems	11
3.	Simply asksthe students to solve one more similar problem	4
4.	Solves similar problems with student participation	12
5.	Selects and solves sufficient number of similar problems.	1

V. INDIVIDUAL AND GROUP WORK

A skilful mathematics teacher attempts to seek balance between the various phases of learning. While he guides the learning he's careful not to do most of the 'talking' or 'telling' himself. Much of the success depends upon the extent of student participation in the development of the lesson. Not all students in a class are at the same level of learning, and student participation can be easily available if teacher plans his work to suit the students of various abilities. Existence of various levels of learning in a class makes grouping an important aspect of teaching. If suitable groups are formed in a class, learning is facilitated.

a) Grouping the students

In this study it was found that out of 42 teachers who were observed 35 did not group the students. They were all the time teaching the class as a whole. Only 4 teachers allowed some group work but grouping in these cases was according to seating arrangement. The remaining 3 teachers allowed group work but groups were formed without any criterion: they were neither according to ability nor according to seating arrangement. All this shows that the teachers do not accept group work as an integral part of teaching and do not plan systematic group activity in class.

During group interviews also, information was obtained on this issue from students. In all, 41 groups of students were interviewed. 25 groups were silent on this point and did not mention anything about group study. Seven groups denied the existence of any such practice. In two cases students reported that group work was encouraged but in only 1 case it was reported that group work is systematically planned for the purpose of furthering learning.

In the remaining seven groups the investigators asked if there was any sort of cooperative study among the students arranged either by the students voluntarily or by the teacher. This was slightly different from what was implied above (i.e. study in small groups under teacher supervision during regular class periods). In these cases student cooperation was reported in doing home-work and also in checking work.

b) Helping in individual difficulties

Many a time a student of mathematics is not able to assimulate concepts, principles and relationships because he has some individual difficulties. When the class is conducted on the basis of heterogeneous grouping and common assignment, individualization is difficult. Whatever approach a teacher may use, the need to look into the individual difficulties of students and give them help to overcome them is always present. This help may be given either in class or outside. The teacher's help available to individual students in the class was studied during both classroom teaching observation and group interview and that available outside the class was studied through students' group interviews.

The 42 teachers observed in this study are rated as follows:

	Category	Frequency
1.	Never attends to individual difficulties	13
2.	Attends to individual difficulties of good students only	1
3.	Attends to individual difficulties of weak students only	8
4.	Attends to individual difficulties of few (irrespective of the bright or the weak)	14
5.	Attends to individual difficulties of almost all.	6

Students' responses on the availability of teacher help did not represent any unanimity even on the same teacher. However, of the 41 groups of students interviewed, 3 groups said that the teachers' help was available outside the class only, 5, inside the class only and 19, both in and out of class.

In the remaining 4 groups, students' opinion of a single teacher is listed below:

1. The teacher was not interested in teaching mathematics and was doing so under compulsion. Because of the teacher's indifference the students never asked him to remove their difficulties.
2. The teacher always taught the whole class and never allowed individual students to put forward his difficulties.

   On most days practically no time was left for resolving individual difficulties in class.

3. The teacher did not care about students' learning and never allowed time for students to put forward their individual difficulties.
4. The teacher had scared the students so much that they felt afraid of asking him their difficulties.

c) Supervision of student work in class

To be really effective the teacher must be continually in touch with the work of every individual student. He should be quick in locating the difficulties and needs of various students. Also, he should avoid imposing himself too much upon them. He should be available wherever his help is needed. In our system of class teaching it is not possible for a teacher to supervise the work of every student in every period, nor is this expected of him.

In this study 41 teachers were observed. They are rated as follows:

	Category	Frequency
1.	Does not supervise student work at all	7
2.	Supervises work on localised basis	15
3.	Supervision is well distributed	8
4.	Supervises almost all	4
5.	Supervises effectively	5

VI. HOME-WORK

Home assignments have been regarded as an important part of mathematics teaching. It is a very common technique to provide more practice to students. Since independent supervised study in classrooms is not always possible, home-work is the only alternative for making children work independently at home.

An attempt was made to collect information about existing practices with regard to various aspects of home-work, viz. how often it is assigned; sources of home-work, checking methods, appropriateness, work habits of students, total load, etc. The information was collected through classroom observation, teacher interview, student interview, checking note-books and a brief questionnaire to students. The findings on various aspects are presented here.

Using home-work in class

In all 41 lessons were observed to note if teachers make any reference to home-work or use it as an activity in the class. These are rated as follows:

	Category	Frequency
1.	Does not refer to home-work	14
2.	Simply signs in class the home-work of pupils	3
3.	Assigns home-work towards the end of the class period.	19
4.	Spends sometime discussing home-work before starting the day's lesson	4
5.	Checks the home-work of selected students only.	1

Class observation thus indicates that the teachers do not take home-work as an instructional activity. It is used in a narrow sense, only to provide additional practice on the topic taught. Only 8 teachers spent sometime in class on home-work, that too only in signing or discussing. None tried in any way to use home-work as a starting point or a means of motivation for the day's lesson.

How often assigned?

To be effective home-work should be assigned regularly. Information was obtained through teacher interview, students' interview and examination of note-books. Out of 40 teachers interviewed, 28 teachers reported that they assign home-work after every period of mathematics 1 teacher reported that he assigned home-work once in a month, the remaining 12 teachers did not assign any home-work regularly.

Out of the 41 groups of students interviewed, 20 groups reported that home-work was assigned to them after every period 9 groups reported that assignments were given but not after every period.

Out of the 41 cases in which home-work note-books were examined, only in 18 it was found that the home-work was given after almost every period. In 5 cases the irregularity was very significant. A few difficulties, such as the students did not put dates on the home-work note-book(not all note-books could be made available) came in way of interpreting the information from home-work note-books in the remaining cases.

Sources of home-work

Sources other than prescribed books are important in assigning home-work. The information about sources was obtained in teacher interview and student interview.

Out of 40 teachers interviewed, 20 teachers reported that they use the prescribed textbook only for assigning home-work, 10 teachers said that at times they used other materials as well. These 10 teachers when questioned further indicated that generally the other sources were books other than the prescribed textbook or examination papers.

Out of the 41 groups of students interviewed only one group reported that the assignments were given from sources other than the textbook, 2 groups specifically mentioned that the assignments were given from the textbook only.

It is, therefore, clear that main source of home-work is the textbook exercises.

Checking the home-work

Effectiveness of home-work also depends upon how it is checked. Checking serves two purposes: it helps the teacher knew the typical difficulties in the topic and also the progress of individual students.

It was found that generally two methods are used for checking home-work. First, group leaders appointed by the teacher check it, which the teacher later signs. Second, the teacher himself checks home-work. When a teacher himself, checks home-work, he may use any of the following methods:

1. Reading out of the correct solution and asking the students to compare.
2. Checking the final answer only.
3. Marking mistakes only.
4. Giving corrections only.
5. Giving corrections with instructions.
6. Entering some remarks in the note-books.

Home-work is checked by some teachers in class and by others outside. Of the 40 teachers interviewed, 24 teachers reported that they check home-work in class, 4 teachers reported that they often checked it outside class also. The teachers who checked home-work in class were further asked about the type of checking they did. 10 teachers said that they merely signed home-work, 10 that they marked mistakes only, 5 that they corrected the work and wrote instructions on the note-books for improvement in written work. Only 5 teachers gave some remarks also. This was by means of offering grades on the work done or other general remarks.

In cases where the teacher checked home-work in class, it was observed that he engaged the class in solving some sums based on the day's lesson while he was busy going through the home-work note-books.

The groups of students interviewed reported the following methods of checking:

	Method of checking	No. of groups who reported
1.	Home-work checked by group-leaders	5
2.	Home-work checked by group-leaders whose work had been checked by the teacher	2
3.	Teacher just signed the note-books	3
4.	Teacher signed home-work only when there is an inspection	1
5.	Teacher announced the correct answers in the class and asked students to check if their answers were correct.	1
6.	Teacher checked one question, mostly the last one, and signed.	1
7.	Teacher noted the problem that most students could not solve and solved them.	5

The group leaders generally checked the number of sums each student had done out of the sums assigned and the answers to the sums. The teachers signed the note-books after they had been checked by group leaders. In one case it was reported that the group leaders were asked to help others in doing home-work in a formal class called a 'study class'.

The examination of home-work note-books also showed a variety in methods of checking. These are noted into five categories, which are not mutually exclusive.

	Category	Frequency
1.	Corrected home-work and gave suggestions for improvement	3
2.	Corrected home-work but gave no suggestions	3
3.	Marked mistakes only	5
4.	Marked mistakes and gave remarks to indicate quality of work done	3
5.	Simply signed the note-book	10

In only 8 cases it was found that the teacher maintained a diary to keep a record of his assessment of students' work. The teachers who gave remarks to indicate the quality of work done did it in two ways, by giving qualitative remarks such as 'good' 'fair', etc. and by grading the work as A, B, ...Only 11 teachers were found to check home-work regularly. The teachers felt that it was difficult to be regular in checking home-work because of heavy class-load.

Load of Home-work

The amount of home-work is also an important issue. Too much of home-work is apt to kill interest in the subject. There is no standard formula to measure the appropriateness of home-work for each student. It was therefore thought proper to ask the students themselves about what they feel about the load of home-work and also enquire about the total time they devotedto home-work in a week.

Out of the 41 groups of students, 21 were of the opinion that the home-work load was appropriate. By this they meant that an average student could do that much of work in about an hour. Five groups reported the load to be inappropriate. Two of these five groups stated that it was more than what could be normally done.

The answers to the question on the time spent on home-work per week show that

24.8% students devoted six hours or more.

34.4% students devoted four to five hours.

32.9% students devoted two to three hours.

7.1% students devoted one hour or less.

Differentiated home-work

The home-work should be appropriate to the needs of individual student. Generally speaking we find three types of students: below average, average, and above average. Teachers can consciously try to give separate assignments that suit each of these types of students or make provision for them in the same assignment.

Observations made under this study show that only one teacher assigned extra work to bright students. All others gave the same assignment to all irrespective of the needs of the slow or the bright. The examination of home-work note-books revealed in many cases that the students used malpractices such as copying the solution from a key to the book or another student's note-book.

Almost all the student-groups confirmed that the same assignments were set for all. Only one group said that the teacher gave them the freedom to do as many as they could, but no special consideration was paid to the needs of the different categories of students.

Study habits

Students should cultivate healthy habits such as being systematic, regular, neat and clear.

The examination of home-work note-books reveals that:

a) A majority of the students kept **systematic record of their home-work.**

b) **A majority of students** tended to reproduce as much as possible from what the teacher wrote for them on the black-board.

c) In 12 cases students had shown interest in class-work.

d) In 19 cases the students were regular in doing assignments.

e) In 7 cases a table of contents was given in the home-work note-book.

f) In 21 cases students had done work systematically.

Through the students' questionnaire information was obtained about the day and time during the day home-work was done by students. No general trends could be detected.

VII. TEACHING AIDS

a) Use of Blackboard

The use of learning aids is an important part of instructional procedure. The use of the blackboard as an aid to learning is undoubtedly the most important part of teaching mathematics. It was, therefore, thought useful to observe how effectively the teachers used the blackboard. The observation of 42 teachers revealed the following:

	Category	Frequency
1.	Uses the blackboard rarely	-
2.	Use of the blackboard inadequate and unsystematic	5
3.	Use of the blackboard adequate but unsystematic	14
4.	Use of the blackboard is inadequate but systematic	2
5.	Use of the blackboard is adequate and systematic.	21

In observing blackboard work handwriting was not assessed.

The other two aspects of blackboard work that were considered were: use of units of measurement and presentation of all the steps for solving the sum.

i) Use of units of measurement

Much of the computational work in mathematics requires the use of measurement. Difficulties in computation arise if students do not label the numbers. Also, results are correct only if they are expressed in proper units. In 18 lessons, out of 42 observed, the use of units was not required. The remaining 24 lessons are rated as follows:

	Category	Frequency
1.	Was not concerned about their use	3
2.	Neither particular of their use himself nor insisted on their use by students	2
3.	Not very particular in their use himself but insisted on their use by students	4
4.	Particular in their use himself but did not insist on their use by students	10
5.	Always used these himself and insisted on their use by the students	5

ii) Link between different steps

A number of steps are necessary in presenting the solution to any problem in mathematics. The steps should also be written in proper sequence and no important step left out. This is important to develop thinking of students and make them used to the rigour of mathematical thinking.

In 40 lessons out of those observed, it was necessary to write steps in proper sequence and link them properly. These are rated as follows:

	Category	Frequency
1.	Did not care to link the steps	6
2.	Was neither particular himself nor insisted on students to link the steps	4
3.	Was not particular himself but insisted on students to link the steps	6
4.	Was particular himself but did not insist on students to link the steps	18
5.	Was particular himself and also insisted on students to link the steps	6

b) Use of other aids

Use of teaching aids other than the blackboard in teaching of mathematics is still a controversial matter. However, some teachers favour their use on the plea that aids help in clarifying the concepts and stimulating thinking.

In 22 lessons out of 42, no teaching aid was required. In 14 lessons teachers did not use any aids although they could have used them. Only six teachers used suitable aids, two of these ineffectively.

c) Textbooks

i) Selection of textbook

Information regarding the selection of textbooks was obtained during the teacher interview. The practices differ from school to school. The major practices and the number of schools which follow them are given below:

	Type	No. of Schools
1.	Books are selected by the Department of Education	12
2.	Books are selected by the management of the school	1
3.	Books are selected by the principal who may or may not consult any other person	9
4.	Books are selected by a committee of teachers appointed by the principal	6
5.	Books are selected by the teacher	6

ii) Use of textbook

Textbooks form the core of instruction in mathematics. Textbooks are in use in class and outside for many purposes. The information collected through classroom observation, interview with teachers and students, and the questionnaire given to students is presented here.

The 39 teachers whose classes were observed are rated as follows:

	Category	Frequency
1.	Did not use the textbook at all	7
2.	Used the textbook only for home assignment	5
3.	Used the textbook for practice exercises and assigning home-work.	25
4.	Used the textbook for the study of descriptive material and solved examples	-
5.	Supplemented the textbook from his own notes	2

Textbooks are thus commonly used for sums to be solved by students in class or at home. Use of textbooks for this purpose was supported by all the 39 teachers who were interviewed. One of these teachers was even of the opinion that a textbook should only include a graded set of problems or exercises. Fourteen teachers reported that they asked their students to read the solved examples. Six teachers reported that they asked their students to read the descriptive material given in the book. One teacher reported that he asked his students to read theorems from the book before coming to the class.

The dependence on textbooks for assigning sums for practice in class and at home was reported by students as well during their interview. They also reported seven cases where the teacher did not consult the textbook at all. When questioned about how teachers used the textbooks, the students reported the following uses:

A. Geometry textbooks

1. Teacher read the statement of the theorem from the book.
2. a) Teacher and/or students read the statement of the theorem.
   b) After proving the theorem, teacher asked the students to read the proof from the textbook, or teacher asked the students to read the theorem in advance, before giving the proof himself.
3. Teacher read the statements from the book and put questions which the students answered after looking into the book.
4. Teacher asked the students to read theorems at home before coming to the class.

B. Arithmetic and Algebra textbooks

1. Teacher read and/or solved the solved examples.
2. Teachers asked the students to read the descriptive material and solved examples for a topic in advance and also after it had been taught.
3. Teacher asked the students to read the descriptive material and solved examples at home and when they found difficulty in solving an exercise.

The questionnaire also included some question on the use of the textbook. It may be mentioned that the information obtained through the questionnaire on these items was different from what was obtained during students' interview and teacher interview. While the questionnaire figures indicate that 10% of the students did not read the solved examples, during their interview the students indicated that they did read solved examples at least when they were unable to solve a sum and a similar solved example could be located. Similarly, the response that 90% students read the descriptive material given in the books as obtained from questionnaires was not supported by the interviews. During teacher interview it was found that rarely did a teacher advise his students to read the descriptive material. Also, during their interview students reported that even when the teacher had advised them to read descriptive material and solved examples, they had avoided reading them.

Q.1. About how much time do you spend per week at home to complete your home-work in Elementary Mathematics only? This should include only that time that you devote to the work assigned to you by the teacher as home-work.

A. Six hours or more ☐
B. Four to five hours ☐
C. Two to three hours ☐
D. One hour or less ☐

Ans.1. The questionnaire was administered to 1528 students. Their replies to this question could be classified as under:

A.	Six hours or more	24.8%
B.	Four to five hours	34.4%
C.	Two to three hours	32.9%
D.	One hour or less	7.1%

The remaining about 1% have either not responded to this question or have replied in a manner where the response cannot be quantified.

2. An important comparison emerges when we study the figures for city areas and mofussil areas in which we have categorised our study. Givenbelow are figures in percentages of students devoting six hours or more per week to home work.

State	City area	Mofussil area.	State as a Union
Bihar	10.3	30.0	16.9
Delhi	39.9	53.3	40.8
Gujarat	11.3	20.9	16.8
Mysore	27.3	14.4	20.9
Punjab	36.0	42.5	38.7

Note: The figures in various tables are in percentages.

Section II.

(An analysis of students' questionnaire)

It is clear that in all the States, except Mysore, the number of students devoting six hours or more is greater in mofussil area than in city area. Mysore becomes a typical case because in two out of the four mofussil schools taken for study teachers had peculiar practice. In one school the teacher assigned home-work once a month which was done in a special note-book by students. In other school, the teacher assigned home-work once a week only.

Ans.3. Some significant differences (10% or more) were found between the city area and mofussil area within a State. These are given below:

Response No.	States									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.	10.3	30.3	39.9	53.3	11.3	20.9	27.3	14.4		
B.			29.4	20.0			30.7	39.8		
C.	45.8	33.6	25.0	13.3			23.5	17.8		
D.						7.6	14.4			

However if the figures are taken together for the five States the differences become almost negligible.

Response No.	No. of Students answering in	
	City are	Mofussil area
A.	24.4	25.5
B.	33.7	35.5
C.	34.1	30.9
D.	7.0	7.0

(This may*because of the figures for Mysore) *be so

Note:- C is a symbol for city and M for mofussil.

Ans.4. The following table gives the inter-state figures for each response. It may be studied for drawing comparisons subject to a few reservations given below:

a) The ratio of respondents from city areas to respondents from mofussil areas is 3:2 in the total respondents from five States.

b) The State-wise ratio of respondents from city areas to respondants from mofussil areas is:

i) Bihar 2:1
ii) Delhi 13:1
iii) Gujarat 1:1
iv) Mysore 1:1
v) Punjab 4:3

c) The limitations inherent because of the size of the sample.

State	Response No.				
	A	B	C	D	?
Bihar	16.9	33.6	41.7	6.2	1.5
Delhi	40.8	28.9	24.2	4.7	1.4
Gujarat	16.3	44.6	32.2	6.3	.6
Mysore	20.9	28.0	39.3	10.9	.8
Punjab	38.7	34.6	21.1	5.6	-
Combined	24.8	34.4	32.9	7.1	.9

The two middle categories contain a very large group of respondents and may be that the discrimination between the two is not very fine. If we just combine the figures for these two. Punjab and Delhi get a similar distribution and so do Bihar and Gujarat. Mysore stands a typical probably because of the reasons stated earlier.

Q.2. When the home-work is not to be shown the next day, do you generally finish it the day it is assigned to you or on the day or the previous day when it has to be shown to the teacher ?

☐ A. The same day when it is assigned

☐ B. On the day it is to be shown to the teacher

☐ C. On a day previous to the day when it is to be shown to the teacher.

☐ D. None of the above.

Ans.1. The replies to this question could be classified as under:

A.	The same day when it is assigned	71.9%
B.	On the day it is to be shown to the teacher	10.5%
C.	On a day previous to the day when it is to be shown to the teacher	15.9%
D.	None of the above.	0.7%

.2. Considering the differences for city areas and mofussil areas within the same state we find that the differences are more significant in case of Bihar. A few of the prominent differences are given here:

Response No.	States									
	Bihar		Delhi		Gujarat		Punjab		Mysore	
	C	M	C	M	C	M	C	M	C	M
A.	71.8	85.5								
B.	6.5	14.5								
C.	18.7	29.0	8.7	20.0	13.6	10.7	10.5	4.4		
D.										

•.3. The following table gives inter-state figures for each response. It may be studied for drawing comparisons subject to the reservations as given in the previous question.

State	Response No.			
	A	B	C	D
Bihar	64.8	9.3	22.2	1.5
Delhi	82.5	6.6	9.5	0.9
Gujarat	83.7	3.6	12.1	0.3
Mysore	47.0	26.1	23.9	0.6
Punjab	88.0	3.0	8.0	0.4
Combined	71.9	10.5	15.9	0.7

One general trend is very clear in the case of Delhi, Gujarat and Punjab, and to some extent in Bihar, that a large majority of students complete the assigned home-work on the day of assignment itself. In Mysore the date of presentation of the work to the teacher governs the date of the students doing it. As a matter of fact, response C is a forced response. Work cannot be postponed any further. This tendency of doing the work at the last moment is present in groups studied in Bihar and Mysore.

Q.3. When do you generally do your home-work ?

☐ A. Just after returning from school
☐ B. Just before evening meals
☐ C. After evening meals.
☐ D. In the morning.
☐ E. No fixed time.

Before presenting the data on these responses a few of the important points which may be kept in view are mentioned.

1. Time of the day when the home-work is done is determined (apart from individual habits) by school timings. In the case of schools starting early morning and closing late afternoon it is not possible to do home-work in the morning or shortly after reaching home from school.
2. In rural areas not much work can normally be done late at night except where electric power is available.
3. The season also determines the time of doing work at home.
4. Social habits also affect the timings.
5. In some places schools work in two shifts.

To facilitate interpretation of the data the time of visits of the research staff along with school timings are given below:

State	Dates of visit	School timings
Bihar	First half of March	10 a.m. to 4 p.m.
Delhi	a) Second half of March b) First half of Sept.	10 a.m. to 4 p.m. a) 7 a.m. to 12.30 p.m. b) 12.45 to 4.30 p.m.
Gujarat	First half of July	a) 10.30 a.m. to 4.30 p.m. b) 12.30 p.m. to 6.00 p.m.
Mysore	Middle of July	10.00 a.m. to 4.00 p.m.
Punjab	a) Last week of May b) Third week of June	7.00 a.m. to 1.00 p.m.

1. The replies to this question can be classified as under:

A.	Just after returning from school	35.5%
B.	Just before evening meals	14.3%
C.	After evening meals	15.5%
D.	In the morning	21.7%
E.	No fixed time	11.7%

2. The table below gives the differences in city areas and mofussil areas in different states.

Response No.	States									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.	22.9	17.3	42.4	66.8	32.8	25.8				
B.	31.3	17.3	11.2	20.0			21.8	7.2		
C.			22.4	6.7	33.9	40.3				
D.	27.6	52.5	11.7	0.0	17.5	23.1	27.8	37.0		
E.							12.6	26.5	18.3	12.

It is clear from above that in case of areas where schools observed day time (10.00 a.m. to 4.00 p.m.) at the time of enquiry and time was available both in mornings and late evening to do the home-work different practice is found in city and mofussil areas. In cities more students work in the evening than in the mornings. In mofussil areas, even where electricity was available, the students work in the mornings than in the evenings.

Again comparison between city and mofussil schools is not desirable as of the seven city schools in the sample, four worked in the morning and 3 in day time, the one mofussil school was a small school working in the morning hours.

3. The following table gives inter-state figures for each response. It may be studied for drawing comparisons subject to the reservations given in Q. 1.

State	Response No.				
	A	B	C	D	E
Bihar	20.9	26.6	7.1	35.8	9.0
Delhi	44.1	11.8	21.3	10.9	10.9
Gujarat	29.2	8.5	37.2	20.4	4.1
Mysore	28.3	14.6	3.3	32.4	19.5
Punjab	65.0	8.6	8.4	0.4	15.8
Combined	35.5	14.3	15.5	21.7	11.7

4. The school timings at the time of this study were the same in Bihar, Gujarat and Mysore. As such another comparison is presented here where responses for A, B, and C for these states have been combined.

Response	State					
	Bihar		Gujarat		Mysore	
A+B+C	63.6	37.3	75.2	74.7	56.3	35.9
D	27.6	52.7	17.5	23.1	27.8	37.0

In this comparison the city and mofussil schools of Gujarat are quite balanced in proportion. Figures for Bihar show that students in mofussil schools work more in the morning. This may be because some people do believe that Mathematics can be better studied with a fresh mind.

Q.4. In addition to the home-work, do you devote any time to the studying of Elementary Mathematics at home apart from your doing so near the examinations?

☐ A. Yes

☐ B. No.

If "yes", indicate below about how many hours per week do you devote to such study excluding the time for home-work.

......................................hours per week.

If the above answer is "yes", what kind of work do you generally do while studying Elementary Mathematics at home. Write your answer in the space provided.

Ans. Ist Part: A very high percentage of students (90%) devoted time to study in addition to the time given to doing home-work. City and mofussil school differences were not very prominent. As such figures for each state are presented for inter-state comparisons only

State	'Yes'	'No'
Bihar	86.4	13.6
Delhi	88.2	11.8
Gujarat	95.3	4.1
Mysore	94.5	5.0
Punjab	83.8	16.2
Combined	90.2	9.2

As stated by students themselves almost every student in Gujarat and Mysore had this type of voluntary study. Figures for Punjab are the lowest.

IInd Part

1. Responses to this querry were grouped as below:

   A. One to two hours.

   B. Three to four hours.

   C. Five to six hours.

   D. Seven and more hours.

   E. Absurd replies or no replies.

These five categories are mutually exclusive and all comprehensive. Presented below are differences (selected) between city and mofussil school student responses.

State	Response	City	Mofussil
Bihar	A	14.7	10.1
Delhi	A	10.5	21.4
	C	26.2	0.0
	D	34.9	50.0
Gujarat	B	51.5	26.7
	C	20.0	15.0
	D	9.1	40.0
Mysore	B	16.2	26.9
Punjab	C	23.8	32.5
	D	28.5	21.5
Combined	A	10.3	8.0

There is no general trend discernable in these differences though at times the difference were very high, e.g. in case of Gujarat in responses (B) and (D).

2. For inter-state comparisons the figures are presented in two groups. Group 1 combines categories A and B, and group 2 combines categories C and D.

State	Group I	Group II
Bihar	39.6	59.7
Delhi	39.4	60.2
Gujarat	49.3	42.5
Mysore	26.5	72.4
Punjab	46.2	53.0
Combined	39.8	57.6

3rd Part: As it was an open ended question the responses were grouped in the following categories:

A. Revision of work done before and pre-study of the new lesson.
B. Study of descriptive material and formulae.
C. Study of solved examples from text-books.
D. Solving of sums from textbooks.
E. Reading theorems and committing them to memory.
F. Study of books other than textbooks.
G. Practising constructions in Geometry.
H. Removal of difficulties, if any.
I. Others.
J. Absurd replies or no replies.

First of all we consider cases where students were not expected to reply because they had answered the first question in the negative and also cases of absurd or no replies.

State	Students					
	City		Mofussil		Total	
	(X)	(Y)	(X)	(Y)	(X)	(Y)
Bihar	10.7	12.6	19.1	1,8	13.6	9.0
Delhi	12.2	11.7	6.7	33.3	11.8	13.3
Gujarat	6.2	9.6	2.2	8.6	4.1	9.1
Mysore	4.9	51.4	5.5	49.7	5.0	50.5
Punjab	15.0	19.0	17.7	33.6	16.2	25.2
Combined	9.6	20.6	9.3	24.6	9.5	22.3

X. Not expected to reply

Y. Absurd or no reply.

50.5% of the students from Mysore gave no reply or an absurd reply. Punjab followed with 25.2% such cases. Nothing can be explained with regard to these figures. Proceeding further below are given the two most frequent responses for each area along with actual frequencies.

State	City	Mofussil	Total
Bihar	D(139),E(63)	D(79),E(31)	D(218),E(94)
Delhi	D(82),A(45)	D(4),A(3),G(3)	D(86),A(48)
Gujarat	A,1(103),D(81)	A(101),D(82)	A(204),D(163)
Mysore	A(63),D(11)	A(67),G(9)	A(130),D(18)
Punjab	D(48),A(26)	D(30),A(17)	D(78),A(43)
Combined	D(361),A(247)	D(202),A(195)	D(563),A(442)

Responses (D) and (A) were very popular. Bihar students were not very responsive to (A) and had (E) as their second preference. The thing which comes out clearly from replies to this question is that students had not taken favourably to responses (B) & (C) concerning descriptive material and formulae, and solved examples. Even though it may not be a conclusive contradiction of what the students had said about these two issues in other questions yet it points to a contradiction. This question has worked as a probe question to the two which followed. It also points to the usefulness of open ended questions.

Q.5. Out side school hours do you study in a group along with other students of your class ?

☐ A. Yes.

☐ B. No.

If "yes", indicate the answer applicable to you out of the following alternatives.

☐ A. The whole year.

☐ B. Only at the time of different examinations.

☐ C. Only at the time of annual examinations.

If you study in agroup, how do you select your partners ?

Ans. Ist Part: The state-wise response to this question in affirmative was as follows:

Mysore	80%
Gujarat	58.4%
Punjab	43.2%
Delhi	37%
Bihar	35.2%

Studying in a group out side school is more popular in mofussil schools.

2nd Part: Here the response A, i.e., the whole year, was more popular.

3rd Part: The responses were grouped as below:

A. Those who live near and are class-fellows.

B. Students who can exchange knowledge in case of need.

C. Intelligent students to get help in case of need.

D. Students who can tell something whenever asked for.

E. Students of good character.

F. Others.

In all States studied the most popular response was 'C'.

Q.6. Is there any one at your home (not a tutor) who can help you in the study of Elementary Mathematics ?

☐ A. Yes.

☐ B. No.

If "yes", indicate below how many persons are there in your home who can help you.

No. of persons ....

If "yes", do you get help from him/her/them

☐ A. Yes, regularly

☐ B. Yes, sometimes

☐ C. No.

If you get any help from any one at your home, in what way do you get it ?

Ans. Ist Part: More than 50% of students replied in the affirmative. The state-wise figures for city and mofussil areas are given below:

State	City	Mofussil	Total
Bihar	66.8	42.7	58.6
Delhi	50.0	26.7	48.3
Gujarat	70.1	45.2	56.5
Mysore	65.6	49.2	57.4
Punjab	60.8	44.2	53.7
Combined	62.6	45.3	55.8

It is clear that greater percentage of city students have some one in the family to help them. It is most common in Gujarat city areas. Delhi mofussil group has the lowest percentage of students getting help from family members.

IInd Part: When questioned on as to how many such persons were there about fifty percent of the students said that they had only one person in the family who helpedthem. Cases where there were three or more such members who could help were less than 20% of the total number who had somebody in the family to help.

IIIrd Part: Only 21.3% of the total number of students got help from the family members regularly. Another 32.4% received help only at times.

IVth Part: This was an open ended question and the responses were grouped as below:

1. Help in solving different questions, when asked for.

B. Help in removing other types of difficulties regarding studies.

C. Others.

Given below are figures in percentage of those who had replied the first question in the negative and were not expected to reply, and also of those who gave absured or no replies.

State	Students not expected to reply	Students giving absured or no replies
Bihar	41.4	9.9
Delhi	51.2	18.5
Gujarat	41.6	8.0
Mysore	41.8	22.8
Punjab	45.5	20.3
Combined		

With the rest of the student the first response was very popular. And it seems to be true otherwise also. Normally help is given when sought for. Rarely somebody in the family would be so particular as to ask the student to sit and work with him.

Q.7. Do you get any tution in Elementary Mathematics from a tutor ?

☐ A. Yes

☐ B. No.

Ans. In all about 20% of the students studied reported having a private tutor at the time of this study. Practice of engaging private tutors was reported to be most popular in Bihar and Mysore. Discernable trends were observed. The state-wise figures are given in Appendix VIII.

Q.8. Did you get any tution in Elementary Mathematics last year ?

☐ A. Yes.

☐ B. No.

Ans. The number of students who had tution in last year was 25% of the total. The state-wise figures are given in Appendix VIII.

Q.9. Do you attend a coaching class or a tution class ?

☐ A. Yes.

☐ B. No.

Ans. The coaching classes did not appear to be very popular in any of the states. On the basis of the responses received Bihar and Mysore come on the top. State-wise figures are given in Appendix VIII.

Q.10. Did you attend a coaching class or a tution class last year ?

☐ A. Yes.

☐ B. No.

Ans. The percentage of students giving affirmative response is higher than the percentage of students who gave affirmative reply to Q.9 practically in all the states. Bihar and Mysore come on the top in this case also.

State-wise figures are given in Appendix VIII.

Q.11. You must have solved the sums from your Arithmetic textbook. Indicate the answer applicable to you in this respect out of the following.

☐ A. I have solved all the examples.

☐ B. I have solved a majority of the examples.

☐ C. I have solved only a few examples.

☐ D. I have not solved any examples other than those that were done in the class.

Ans.1. The responses were grouped as under:

A.	I have solved all the examples	25.5%
B.	I have solved a majority of the examples.	41.6%
C.	I have solved only a few examples.	21.7%
D.	I have not solved any examples other than those that were done in the class.	10.6%

Ans.2. The state-wise responses for city and mofussil areas are given in the following table. The comparisons can be drawn subject to the restrictions given in Question 1.

Response No.	States									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.	13.1	27.3	13.8	26.7	28.2	50.4	20.8	26.3	22.9	30.9
B.	58.0	46.4	57.5	46.7	53.1	32.2	17.5	29.9	48.3	24.8
C.			20.5	13.3						
D.	11.6	9.1	7.2	13.3			21.3	9.4	5.2	19.4

In case of responses A and B a pattern can be found. For A, the percentage of mofussil school students is higher than the city school students. For B, the response is higher in city schools in all the states except Mysore.

Ans.3. For inter-state comparisons the following table may be helpful.

State	Response A	B	C	D
Bihar	17.9	53.4	17.9	10.8
Delhi	14.7	56.9	19.9	7.5
Gujarat	39.7	42.4	9.1	7.7
Mysore	23.2	23.2	36.3	15.4
Punjab	26.3	38.3	24.1	11.3

Here Punjab appears to be the nearest to the combined figures and Delhi probably the farthest.

If we combine the figures for the first two responses are combined on the grounds that each and every sum may not be considered as a must, to be solved by every student a different type of picture emerges.

Bihar	71.3
Delhi	71.6
Gujarat	82.1
Mysore	46.4
Punjab	64.6
Combined	67.1

In this regrouping Punjab continues to be nearest to the overall but extreme deviates are Mysore and Gujarat.

Q.12. What kinds of sums have you omitted in Arithmetic so far?

Ans. The responses for the question were not analysed because of this element of unrealiability in the data reported. As a matter of fact this question could not be interpreted unless the total number of topics covered were also noted.

Q.13. You must have solved the sums from your Algebra text-book. Indicate the answer applicable to you in this respect out of the following:

☐ A. I have solved all the examples.
☐ B. I have solved a majority of the examples.
☐ C. I have solved only a few examples.
☐ D. I have not solved any examples other than those that were done in the class.

Ans.1. This question is similar to Q.11 which was on Arithmetic. The responses were grouped as under:

A.	I have solved all the examples	28%
B.	I have solved a majority of the examples.	38.8%
C.	I have solved only a few examples	20.9%
D.	I have not solved any examples other than those that were done in the class.	11.2%

Ans.2. The significant differences in state-wise responses for city and mofussil areas are given in the following table. The comparisons can be drawn subject to the restrictions given in Q.1.

Response No.	States									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.	18.7	35.5	17.4	33.3	33.4	53.7	19.7	26.3	19.7	30.9
B.	56.1	35.5			50.8	30.7	14.2	22.6	49.0	23.0
C.	16.9	21.8	18.9	6.7			44.2	32.2		
D.									6.5	23.0

For response A percentage in mofussil schools was consistently higher than that in city schools. For response B the case was reverse with the exception of Mysore. For Delhi, though the difference in response B for city and mofussil schools was not high yet it followed the general trend. Quite conspicuous was the figure of 23% against response D in Punjab mofussil schools. This implies that almost one-fourth of the students did only that much Algebra that had been done in the class.

Ans.3. For inter-state comparisons the following table is given:

State	Response No. A	B	C	D
Bihar	25.0	49.1	18.6	7.1
Delhi	18.4	56.4	18.0	6.6
Gujarat	43.7	40.5	6.3	8.0
Mysore	23.1	18.4	38.2	18.6
Punjab	24.4	37.9	22.6	13.5
Combined	28.0	38.8	20.9	11.2

Here also, as in Q.11, Punjab came nearest to the combined figures and Delhi, probably, the farthest. The number of responses to response A shows an increase in case of Bihar and Delhi as compared to the number of responses to response A in Q11. For response D also the percentage has gone up in all cases except for Gujarat.

Considering responses 'A' + 'B' as a group as done earlier we get the following picture

Bihar	74.1
Delhi	74.8
Gujarat	84.2
Mysore	41.5
Punjab	62.3
Combined	64.8

Though Punjab continues to be the nearest to the overall position, the range has increased from 82.1-46.4 = 35.7 for Arithmetic to 84.2-41.5 = 42.7 for Algebra. This may be because of varying relative emphasis on different branches of mathematics. Similarly we find that the range of % in response D has also increased from 15.4-7.5 = 7.9 for Arithmetic to 18.6-6.6 = 12.0 for Algebra. This further supportes our inference of varying emphasis on different branches of mathematics.

Q.14. What kind of sums have you omitted in Algebra so far?

Ans. The responses for this question were not analysed because of the element of unreliability in the data reported. As a matter of fact this question could not be interpreted unless the topics already taught were also taken into consideration.

Q.15. You must have studied theorems in Geometry. Indicate the answer that is applicable to you out of the following in connection with theorems.

☐ A. I have understood practically all the theorems.

☐ B. I have understood all the theorems and remember all of them.

☐ C. I have understood some of them but remember practically all of them.

☐ D. I have not understood most of the theorems but remember some of them.

☐ E. I neither have understood nor remember any of the theorems.

Ans.1. The responses were grouped as under:

A.	I have understood practically all the theorems.	30%
B.	I have understood all the theorems and remember all of them.	33.2%
C.	I have understood some of the theorems but remember practically all.	24.7%
D.	I have not understood most of the theorems but remember some of them.	5.4%
E.	I have neither understood any theorem nor do I remember any.	less than 1%

Nearly 6% responses were absurd replies.

2. The significant differences in state-wise responses for city and mofussil schools are given in the following table. The comparisons may be drawn subject to the reservations mentioned in Q.1.

Response	States									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.			17.4	40.0	71.8	43.4	12.6	21.5	17.6	22.1
B.			38.3						26.8	15.0
C.							29.7	13.8		
D.			3.1	20.0						
E.										

The most spectacular among these figures is that for response A in the city schools of Gujarat. About 72% of the students said that they had understood practically all theorems and another approximately 14% (not reported in the above table though reported in the Appendix) claim to have understood and remembered all theorems.

Ans.3. The following table gives an inter-state comparisons.

	Response					
State	A	B	C	D	E	?*
Bihar	30.0	42.6	26.2	1.2	0.0	0.0
Delhi	18.9	36.5	21.8	4.2	0.5	18.0
Gujarat	57.3	16.5	21.2	0.6	0.0	4.4
Mysore	17.0	48.0	21.7	3.3	0.0	9.9
Punjab	19.6	21.8	33.9	20.7	3.0	1.1
Combined	30.0	33.2	24.7	5.4	0.6	1.1

(*Absurd replies or no replies)

The figures of 57.3% in category 'A' in Gujarat, 48.0%and 42.6% in category 'B' for Mysore and Bihar respectively and that of 18.0% in case of Delhi of absurd or no replies are conspicuous. Categories 'A' and 'B' may be combined to see the general effect on statistics. These two categories may be combined because both involve the understanding of theorems.

Bihar	72.6%
Delhi	55.4%
Gujarat	73.8%
Mysore	65.0%
Punjab	41.4%
Combined	63.2%

Punjab figures deviates the most from the combined figure and Mysore figures are the nearest. Figures for Gujarat and Bihar are really encouraging if the students replies were unbaised.

Q.16. You must have solved "riders" in Geometry based on different theorems. In connection with "riders" indicate the answer that is applicable to you out of the following:

☐ A. I have done practically all the riders from my text-book.

☐ B. I have done only some selected riders from my text-book.

☐ C. I have done only those riders which were solved in the class.

Ans.1. The responses were grouped as under

A.	I have done practically all the riders from my text-book.	18.1%
B.	I have done only some selected riders from my text-book	41%
C.	I have done only those riders which were solved in the class.	35.9%

Nearly 5% responses were absurd replies.

.2. The significant differences in state-wise responses for city and mofussil schools are given in the following table. The comparisons may be drawn subject to restrictions in Q.1.

Response No.	State									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.	16.9	5.5	20.5	33.3			10.4	16.6		
B.					36.6	29.6				
C.			20.9	33.3						
D.			18.9	0.0						

The figure 33.3% in category 'A' for Delhi mofussil schools is quite high. Two other places where the figures for this category were quite high are Gujarat's city and mofussil areas. The figures for the two are 27.7% and 31.7% respectively.

.3. The following tables gives inter-state comparisons.

	Response No.			
State	A	B	C	D
Bihar	13.0	59.0	28.1	0.0
Delhi	21.3	39.3	21.8	17.5
Gujarat	29.8	33.1	34.2	3.0
Mysore	13.5	37.6	41.5	7.4
Punjab	12.4	35.7	51.1	0.8
Combined	18.1	41.0	35.9	5.0

Gujarat's figure for category 'A' seems to be quite unusual. 51.1% in category 'C' for Punjab speaks of a situation worth consideration. Again in category 'D' Delhi has 17.5% cases. This cannot be explained as to how such a high percentage of absurd replies could be there. For this question it may be convenient to combine categories 'B' and 'C' and see the effect. Both of these categories point to selected work to varying degree.

	B + C
Bihar	87.1%
Delhi	61.1%
Gujarat	67.3%
Mysore	79.1%
Punjab	86.8%
Combined	76.9

The high percentages in this table are significant and indicate the practice of doing the selected riders.

Q.17. In addition to theorems and their riders, you must have studied "Constructions" in Geometry. Which one of the following answers is applicable to you in connection with "constructions".

☐ A. I have done practically all the constructions given in my text-book.

☐ B. I have done some selected constructions from my text-book.

☐ C. I have done only these constructions which were done in the class.

Ans.1. The responses could be grouped as under:

A. I have done practically all the constructions given in my text-book. 24.7%

B. I have done some selected constructions from my textbook. 35.5%

C. I have done only those constructions which were done in the class. 35.4%

Nearly 4.4% of the responses were absurd replies.

Ans.2. The significant differences in state-wise responses for city and mofussil are given in the following table. Comparisons can be drawn subject to the restrictions given in Q.1.

Response No.	States									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.	18.2	22.7			30.5	42.5	13.7	20.9	26.8	15.0
B.			31.6	40.0						
C.			21.5	26.7	37.3	24.2	44.2	36.4	41.2	54.9

Except in the case of Punjab, the general trend is of the percentage to be higher for mofussil school than for city schools as regards category 'A'. Even in Dalhi this trend is therefore category A. A very low figure of 13.7% in case of Mysore city schools for this category needs attention. In constructions it is **claimed** to develop skills too but if there is negligence in doing constructions the consequential effect on that skill development can be visualised. Again, figure of 42. category A for Gujarat mofussil schools is also quite high considering other state figures.

Ans.3. Inter-state comparisons can be had from the following table.

State	A	B	C	Absurd Replies
Bihar	19.8	45.1	39.6	0.6
Delhi	28.4	32.2	21.8	17.5
Gujarat	36.6	30.0	30.6	2.7
Mysore	17.3	38.2	40.4	4.1
Punjab	21.8	30.1	47.0	1.1
Combined	24.7	35.5	35.4	4.4

Combining categories B and C we get a picture more indicative of the differences is got:

Bihar	84.7%
Delhi	54.0%
Gujarat	60.6%
Mysore	78.6%
Punjab	77.1%
Combined	70.9%

Bihar and Delhi are on the two extremes. The figures for Delhi when considered with 17.5% absurd replies come very close to the combined figures. It can be inferred that about 70% students do a few selected constructions only.

Q.18. Besides exercises, there are a few solved examples given in all the chapters in your text-books. Have you studied these examples ?

☐ A. Yes, practically all examples.
☐ B. Yes, some of the examples.
☐ C. No.

If "yes", for what purpose did you study these examples.

Ans.1. The responses were grouped as under:

A.	Yes, practically all examples	31.4%
B.	Yes, some of the examples	57.5%
C.	No.	

Nearly 1.5% replies were absurd replies. From these figures it appears that about one third students read all the solved examples was further supported by the group interview of students in which about 10% reported that they do not read the solved examples at all. The teacher interviews however do not support these figures as most of the teachers felt that students do not read solved examples or at least they do not advise them to read them.

Ans.2. The significant differences in state-wise responses for city and mofussil areas are given in the following table. Comparisons can be drawn subject to the restrictions given in Q.1.

Response No.	States									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.	24.8	39.1	38.3	66.6			21.4	26.5		
B.	12.9	4.5	55.5	33.3						
C.							12.0	7.2		

Ans.3. Inter-state differences can be had from the following table.

State	Response No. A	B	C
Bihar	29.6	59.9	10.2
Delhi	40.5	54.0	5.7
Gujarat	38.3	46.3	12.8
Mysore	23.9	63.5	9.6
Punjab	27.3	64.3	7.5
Combined	31.4	57.5	9.6

Bihar and Punjab show a similarity in distribution pattern with Mysore following it in a nearly similar manner. Delhi and Gujarat figures are quite different. Bihar comes nearest to the distribution of the combined figures.

IInd Part

The responses could be categorised as under:

A. For the sake of practice

B. Help in solving sums in a systematic way.

C. For better knowledge of the subject.

D. Set in the examinations

E. Others.

F. No replies or absurd replies.

There are certain limitations imposed on figures related to these responses. This question was meant for those only who had responded to the main question in the affirmative. Also that the last two categories i.e. 'others' and 'replies or absurd replies' were such that a student had been put in one of these two in case he could not be placed in one or more of the first four ones. Category 'others' contains a very small number, almost negligible. Given below are figures relating to city and mofussil area students who were either not expected to reply this question or replies in an absurd way.

State	Not expected to reply		Absurd replies	
	City	Mofussil	City	Mofussil
Bihar	12.9	4.5	10.3	10.9
Delhi	6.1	0.0	24.0	13.3
Gujarat	14.1	11.8	18.6	15.6
Mysore	12.0	7.2	60.7	50.8
Punjab	6.5	8.8	13.1	38.9
Combined	10.5	8.3	25.1	29.6

In Mysore percentage of students giving absurd replies is very high. Though it is not very safe to hazard a guess about reasons therefore yet if one teacher there could opine that a text-book should be a list of problems only this high percentage may not need an explanation.

4

Next in order are Punjab mofussil and Delhi city schools. With the exception of Punjab, city students in other States are slightly more prone to giving absurd replies as compared to mofussil students. The very slight difference in the case of Bihar students may be considered as negligible.

For rest of the responses below are given from each state the number of the two most frequent responses.

State	The two most frequent responses with actual frequencies in brackets. City	Mofussil	Total
Bihar	B(74),C(53)	B(46),C(35)	B(120),C(88)
Delhi	B(101),D(28)	C(6),B(5)	B(106),D(30)
Gujarat	C(56),B(49)	C(87),B(45)	C(143),B(94)
Mysore	A(29),D(10)	A(56),D(14)	A(86),D(24)
Punjab	A(79),D(28)	B(44),C(7)	B(123),D(30)
Combined	B(306),C(148)	B(143),C(141)	B(449),C(289)

Responses B and C are the most frequent considering the overall position. But what is surprising is that in three of the city areas the second place goes to responsed. This shows a weakness of our papersetters. This is more apparent in the case of Mysore where the second place is mofussil schools also goes to this response. This is indicative of the fact how examinations control the learning practices. This also may mean a bias in the minds of authors who might be selecting questions from different examination papers to be put as solved examples in the text-book thereby exploiting these solved examples as an incentive for purchasing their books.

Q.19. In addition to the solved examples and exercises, there is some explanation given in every chapter for the new topic. Do you read it?

☐ A. Yes, from practically every chapter.

☐ B. Yes, in case of few chapters.

☐ C. No.

Ans.1. The responses to this question could be grouped as under:

A.	Yes, from practically every chapter	35.8%
B.	Yes, in case of a few chapters	51.8%
C.	No.	

Nearly 1% of the replies were absurd. The pattern of responses is similar to that in Q. 18. The explanations or discriptive materials are read by nearly 90% students. These figures were supported by students interviewsbut did not get support from teacher interviews. The teachers, in general, felt that students do not read the descriptive material or at least they do not advise them to read it.

Ans.2. The significant differences in state-wise responses for city and mofussil areas are given in the following table. Comparisons can be drawn subject to restriction given in Q.1.

Response No.	States									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
A.			33.2	40.0						
B.										
C.			15.3	6.7					19.0	10.6

In general, the data for city and mofussil schools did not show significant differences.

Ans.3. For inter-state comparisons the following table is given:

	Response No.		
State	A	B	C
Bihar	36.8	55.2	7.7
Delhi	33.6	51.2	14.7
Gujarat	45.7	39.3	12.9
Mysore	30.0	60.9	8.0
Punjab	30.5	53.0	15.4
Combined	35.8	51.8	11.4

The data for Delhi seems to be the most representative of the combined figures and data for Gujarat seem to be the most deviant.

Q.20. In addition to your text-book, do you use any other books (excluding the guide books) ?

☐ A. Yes.

☐ B. No.

Ans.1. The responses could be grouped as under

A. Yes 49%

B. No 49.6%

Nearly 1.5% replies were absurd replies.

Ans.2. The significant differences in state-wise responses for city and mofussil schools are as under:

State	Response	City	Mofussil
Mysore	Yes	38.3	55.2
	No	58.5	44.2
Punjab	Yes	45.8	26.6
	No	53.6	73.4

A peculiar feature emerges out of figures for the two responses. In all states individually and separately the figures for any category were between 40 to 60 percent except for Mysore city area where the first response had only 38.3% case. In Punjab mofussil schools the responses were 26.6% and 73.4% respectively. The combined figures in city and mofussil areas for the two responses were 49.2% and 49.5% and 48.8% and 49.7% respectively.

3. For inter-state differences the following table may be helpful.

State	Response No. 'Yes'	'No'
Bihar	54.3	45.4
Delhi	52.1	47.4
Gujarat	53.2	43.7
Mysore	46.7	51.4
Punjab	37.5	62.0
Combined	49.0	49.6

The pattern is similar in Bihar, Delhi and Gujarat. Mysore figures are nearest to combined figures and Punjab figures are the most deviant.

Q.21. Do you use any guide books ?

☐ A. Yes.

☐ B. No

If "yes", state below what kind of guide-books you use and whether you use guide-books for all the three subjects viz. Arithmetic, Algebra and Geometry.

Ans.1. The responses reveal that 29.9% of the students use guide-books whereas 69.1% do not use any guide-book.

2. The significant differences in state-wise responses for city and mofussil areas are given in the following table:

State	Response	City	Mofussil
Bihar	Yes	53.2	35.5
	No	46.3	64.5
Delhi	Yes	35.2	80.0
	No	64.8	20.0
Mysore	Yes	27.3	47.0
	No	71.1	50.3
Gujarat	Yes	1.1	3.2
	No	96.1	96.8

Normally it is expected that the staff position in city schools will be better and as such use of guide-books will be restricted. The situation in Bihar was quite different. Out of the five classes visited in city area in Bihar two had teachers who were not interested in teaching or teaching mathematics. Use of help books will normally be in some inverse ratio to the standard of teaching. There are two other figures which need some explanation. In Delhi mofussil area the figure of 80% was very high. This was based on one class consisting of 15 students and where the teacher had joined only about a week earlier. Naturally, the students depended more on help books. The investigation is unable to give any explanation for the figure 47% in the case of Mysore mofussil schools. The figures for Gujarat were most conspicuous.

Ans.3. Inter-states comparisons can be drawn from the following table:

State	Yes	No
Bihar	47.2	52.5
Delhi	38.4	61.6
Gujarat	2.2	96.4
Mysore	36.9	60.9
Punjab	30.1	69.1
Combined	29.9	69.1

Punjab approximates best to the combined figures. For Punjab, the distribution (given below) of city and mofussil students in the two categories is almost the same.

	Yes	No
City	30.1	68.6
Mofussil	30.0	70.0
Total	30.1	69.1

IInd Part

The responses to this question were grouped as below:

A.	Arithmetic
B.	Algebra
C.	Geometry
D.	Test-papers
E.	Others
F.	None
G.	Absurd replies.

Considering that this question was a subsidiary to proceeding one we first consideration is given to the number (in percentage of students who had replies the first question in the negative or have given an absurd reply to the second.

State	City	Mofussil	Total
Bihar	53.3	69.0	58.7
Delhi	69.9	33.3	67.3
Gujarat	98.8	98.4	77.4
Mysore	86.9	67.4	77.4
Punjab	73.8	89.5	80.4
Combined	75.7	80.5	80.4

Proceeding further to know the most frequent responses we find the following position is found.

Distribution of most frequent responses along with actual number of responses.

State	City	Mofussil	Total
Bihar	B(62),A(60)	F(31),A(25)	A(85),B(85)
Delhi	B(36),C(35)	B(5),C(5)	B(41),C(40)
Gujarat	E(1),F(1)	F(6),A(3)	F(7),A(3)
Mysore	A(12),B(12)	A(39),B(35)	A(51),C(46)
Punjab	C(23),A(20)	A(11),B(9)	A(31),C(31)
Combined	B(129),A(125)	A(82),B(72)	A(207),B(201)

The over all situation may be gauged from the fact that responses A and B are most frequent followed by a close near (C). This means that a majority of the students depended upon Arithmetic and Algebra for a pass. The reason for studying help-books in Geometry seemed to be a definite neglect on the part of teachers regarding the study of riders in geometry. The students sought protection in these help books if there was no alternative source of help. This guess is hazarded because of the fact that even though the total number of responses for Geometry were less than those for Arithmetic and Algebra yet there are students who had responded only for Geometry. This revealed another trend. Many a student just read solved examples wherever available and they took to any book containing such things. This is decidedly a bad trend if it existed or exists actually.

Q.22. Have you used question papers of the past examinations in Elementary Mathematics ?

☐ A. Yes

☐ B. No

If "yes, have you used solved question papers ?

☐ A. Yes

☐ B. No

Ans. Part I.

1. The number of students responding to this question in affirmative varies from a minimum of 62.9% in Bihar to a maximum of 70.6% in Mysore with 66.3% being the combined figure for all the states.

2. The inter-state differences are not significant.

Part II.

1. Normally two types of question papers are used by students, viz. (i) solved question papers, (ii) unsolved question papers. 43.2% of the students use solved papers.

2. The significant differences in state-wise responses for city and mofussil areas are given in the following table.

Response	State									
	Bihar		Delhi		Gujarat		Mysore		Punjab	
	C	M	C	M	C	M	C	M	C	M
Solved papers	53.7	46.4	35.2	40.0	48.0	38.7	48.1	46.5	30.7	38.1
Unsolved papers	11.2	13.6					18.6	24.6	42.5	25.7

Unsolved papers are more popular among mofussil students in all the states except Punjab where they are more popular among city students.

3. Inter-state comparisons are given in the following table:

State	Responses		
	Solved Question papers	Unsolved question papers	No Question papers
Bihar	51.3	12.0	36.5
Delhi	36.6	29.4	35.1
Gujarat	43.3	20.1	34.7
Mysore	47.3	21.3	28.0
Punjab	33.9	34.0	31.7
Combined	43.2	22.4	32.9

In Punjab the use of solved question papers is the minimum though the use of unsolved question papers is the maximum. Bihar stands at the other extreme where solved papers are used by more than half the students (studied) and unsolved are used by less than one fourth of this number.

Q.23. Mention below the way in which you prepared yourself in Elementary Mathematics for the last annual examination.

Ans.1. The responses were grouped as under:

A. Read, remembered and understood theorems.

B. Remembered the formulae of Arithmetic, Algebra, Geometry, etc.

C. Practised 'construdtions' in Geometry.

D. Selected certain topics from the books to prepare for the examinations.

E. Solved important questions from textbooks.

F. Solved most of the questions from textbooks and other sources.

G. Revised the whole course.

H. Got regular help in studies.

I. Read solved examples from text-books.

J. Others.

K. Revised questions done in the class.

.2. For each state the two most frequent responses are listed below along with their actual frequencies,

State	Responses and Frequencies.
Bihar	J(116),F(85)
Delhi	E(71),J(49)
Gujarat	F(149),A(130)
Mysore	J(95),G(82)
Punjab	J(61),G(51)
Combined	F(351),J332)

The most unhappy part of the responses to this question was the vagneness with which responses had been written. Probably the offend of the questionnaire contributed to it too. Of the two popular responses one is 'Others' with a frequency of 332. With another 118 students who gave absurd replies or left the questions unanswered it appears that this question was not taken up seriously by the respondents.

Q.24. State the purpose for which you study the subject of elementary mathematics.

Ans. The replies received were classified in the following twelve categories.

A. To widen mental outlook.

B. For passing the examinations with good marks.

C. Help in the study of other subjects.

D. Due to liking and interest in the subject.

E. For making the knowledge of the subject sound.

F. One of the essential steps to the study of higher education in various branches, viz. Engineering, Medicine, Science, Arts, etc.

G. To have chances of better employment after studies.

H. Use in everyday life.

I. Others.

J. None.

K. One of the compulsory subjects in our studies.

L. No replies or absurd replies.

First of all consider the last category, viz. 'No replies or absurd replies'. A person who is giving such type of a reply will be giving only one response whereas others may if they feel like give more than one objectives of studying Elementary Mathematics. The distributions of the response is presented below:

State	Students giving no replies or absurd replies		
	City	Mofussil	Total
Bihar	11.2	3.6	8.6
Delhi	4.1	0.0	3.8
Gujarat	4.5	5.4	5.0
Mysore	10.9	12.2	11.5
Punjab	11.1	26.6	17.7
Combined	8.3	10.9	9.4

As pointed out earlier the case of Delhi mofussil schools was a typical. There was only one school with fifteen students and other difficulties. Out of the other four cases Bihar was not in line with others. The general trend appears to be of mofussil school students giving more responses in this category. Punjab mofussil schools figure is conspicuously high. This group included three Government schools.

Next the two most frequent objectives stated by students are considered. The table below gives the category number and also the actual number of responses in that category.

State	City	Mofussil	Total
Bihar	F(72),E(51)	D(27),E(27)	F(92),E(78)
Delhi	F(53),H(51)	H(4),I(4)	H(55),F(54)
Gujarat	F(109),H(68)	F(86),H(80)	F(195),H(148)
Mysore	H(73),F(27),G(27)	H(110),A(26)	H(183),F(49)
Punjab	F(42),D(36)	H(26),D(21)	H(57),D(57)
Combined	F(303),H(233)	H(237),F(135)	H(470),F(438)

A definite difference in outlook of city and mofussil students is discernible. Response (F) appeared as one of the two most frequent in all the city areas studied. On the other hand response (H) was more popular with students in mofussil schools.

Appendix I

LIST OF THE SCHOOLS VISITED FOR TEACHING-LEARNING PROCESSES

PUNJAB STATE

1. A.S. Higher Secondary School, Ambala.
2. Government High School, Maulana.
3. S.D. Higher Secondary School, Ambala Cantt.
4. Government Girls' Higher Secondary School, Ambala City.
5. Mukand Lal National Higher Secondary School, Yamunanagar.
6. Government Girls High School, Nariangarh.
7. Sohan Lal Girls Higher Secondary School, Ambala City.
8. Government High School, Khizrabad West.

BIHAR STATE

1. Shri Krishna Marwari Multipurpose School, Modameh.
2. Shrimati Girja Kanwar Higher Secondary School, Massuhri.
3. Shri Ganesh Higher Secondary School, Bakhtiarpur.
4. Shri Marwari Multipurpose School, Chowk, Patna City.
5. Bankipur Girls Multipurpose Higher Secondary School, Patna-1.
6. Patna Collegiate School, Dariyapur Gola, Patna-4.
7. Miller Higher Secondary School, Patna.

DELHI

1. Municipal Corporation Higher Secondary School, Rouse, Avenue, New Delhi.
2. Quetta D.A.V. Higher Secondary School, Nazamuddin, New Delhi.
3. Ramjas Higher Secondary School, Chitra Gupta Road, New Delhi.
4. Govt. Girls Higher Secondary School, Shakti Nagar, Delhi.
5. Govt. Girls Higher Secondary School, Manakpur, New Delhi.
6. I.A.F. Central School, Club Road, New Delhi.
7. Govt. Higher Secondary School, Shahbad, Mohd.pur, Delhi Cantt.
8. Govt. Multipurpose Higher Secondary School, Roop Nagar No.2, Delhi.

GUJARAT STATE

1. Navchetan High School, Ahmedabad.
2. Sheth Bhikhabhai High School, Isanpur Mota.
3. Vidya Mandir, Naroda.
4. Vakharia P.J. High School, Kalol.
5. Asarwa Vidyalaya, Asarwa.
6. Sheth J.H. Sonawala High School, Mehemadabad.
7. Shri Jivkor Vanita Vishram High School, Ahmedabad.
8. R.M. Trivedi New Education High School, Ahmedabad.

MYSORE STATE

1. Rastriya Vidyalaya High School, Bangalore.
2. Municipal High School, Hoskote.
3. Shri Siddha Ganga High School, Tumkur.
4. Rural Multipurpose High School, Kanakpura.
5. Empress Girls High School, Tumkur.
6. Rastriya Vidyalaya Girls' High School, Bangalore.
7. Vani Vilas Institute for Girls, Bangalore.
8. Government High School, Fort, Bangalore.

Appendix II

Name of the Student______________________________

Name and Address of the School____________________

____

Class____________Section____________Date____________

Do you reside in the Hostel ?____________________

____

Instructions to Students

In this booklet some questions have been addressed to you to obtain information about the study of Elementary Mathematics. This information is to be used in a research programme taken up for the whole country. You are, therefore, requested to give correct and accurate information under each question. The success of this research and its use in future for the benefit of the students like you will depend on the correctness and accuracy with which you answer these questions. So, take enough time to answer every question and give the exact answer.

Please answer each and every question given in the booklet without omitting any of them.

Most of the questions given in this booklet are accompanied by alternative answers from which you are to select the alternative that applies to you.

Wherever such alternative answers are given to a question, you are to select one and only one answer that is applicable to you. Please indicate this answer by putting a cross (x) in the box (☐) provided.

For example, answer the following item.

In which class are you studying at present ?

☐ A. 8th class
☐ B. 9th class
☐ C. 10th class
☐ D. 11th class

☐ E. None of the above.

You must have put the cross in one box only to indicate your answer. In the same manner you have to indicate only one answer for each question where alternatives are given.

1. About how much time do you spend per week at home to complete your home-work in Elementary Mathematics only? This should include only that time that you devote to the work assigned to you by the teacher as home-work.

☐ A. Six hours or more
☐ B. Four to five hours
☐ C. Two to three hours
☐ D. One hour or less.

2. When the home-work is not to be shown the next day, do you generally finish it the day it is assigned to you or on the day or the previous day when it has to be shown to the teacher?

☐ A. The same day when it is assigned
☐ B. On the day it is to be shown to the teacher
☐ C. On a day previous to the day when it is to be shown to the teacher.
☐ D. None of the above.

3. When do you generally do your home-work ?

☐ A. Just after returning from school
☐ B. Just before evening meals
☐ C. After evening meals
☐ D. In the morning
☐ E. No fixed time.

4. In addition to the home-work, do you devote any time to the study of Elementary Mathematics at home apart from your doing so near the examinations ?

☐ A. Yes
☐ B. No

If "yes", indicate below about how many hours per week do you devote to such study excluding the time for home-work.

________________________________hours per week.

If the above answer is "yes", what kind of work do you generally do while studying Elementary Mathematics at home? Write your answer in the space provided.

5. Outside school hours do you study in a group along with other students of your class ?

☐ A. Yes

☐ B. No

If "yes", indicate the answer applicable to you out of the following alternatives.

☐ A. The whole year.

☐ B. Only at the time of different examinations.

☐ C. Only at the time of annual examinations.

If you study in agroup, how do you select your partners ?

6. Is there any one at your home (not a tutor) who can help you in the study of Elementary Mathematics?

☐ A. Yes

☐ B. No

If "yes", indicate below how many persons are there in your home who can help you

No. of persons__________________.

If "yes", do you get help from him/her/them.

☐ A. Yes, regularly

☐ B. Yes, sometimes

☐ C. No

If you get any help from any one at your home, in what way do you get it ?

7. Do you get any tution in Elementary Mathematics from a tutor ?

☐ A. Yes.
☐ B. No

8. Did you get any tution in Elementary Mathematics last year?

☐ A. Yes.
☐ B. No

9. Do you attend a coaching class or a tution class ?

☐ A. Yes
☐ B. No

10. Did you attend a coaching class or a tution class last year?

☐ A. Yes
☐ B. No

11. You must have solved the sums from your Arithmetic text-book. Indicate the answer applicable to you in this respect out of the following.

☐ A. I have solved all the examples.
☐ B. I have solved a majority of the examples.
☐ C. I have solved only a few examples.
☐ D. I have not solved any examples other than those that were done in the class.

12. What kind of sums have you omitted in Arithmetic so far?

13. You must have solved the sums from your Algebra text-book. Indicate the answer applicable to you in this respect out of the following.

☐ A. I have solved all the examples.
☐ B. I have solved a majority of the examples.
☐ C. I have solved only a few examples.
☐ D. I have not solved any examples other than those that were done in the class.

14. What kind of sums have you omitted in Algebra so far ?

15. You must have studied theorems in Geometry. Indicate the answer that is applicable to you out of the following in connection with theorems.

☐ A. I have understood practically all the theorems.

☐ B. I have understood some of them but remember practically all of them.

☐ C. I have not understood most of the theorems but remember some of them.

☐ D. I neither have understood nor remember any of the theorems.

16. You must have solved "riders" in Geometry based on different theorems. In connection with "riders" indicate the answer that is applicable to you out of the following.

☐ A. I have done practically all the riders from my text-book.

☐ B. I have done only some selected riders from my text-book.

☐ C. I have done only those riders which were solved in the class.

17. In addition to theorems and their riders, you must have studied "Constructions" in Geometry. Which one of the following answers is applicable to you in connection with "constructions"?

☐ A. I have done practically all the constructions given in my text-book.

☐ B. I have done some selected constructions from my text-book.

☐ C. I have done only those constructions which were done in the class.

18. Besides exercises, there are a few solved examples given in all the chapters in your text-books. Have you studied these examples?

☐ A. Yes, practically all examples.

☐ B. Yes, some of the examples.

☐ C. No

If "yes", for what purpose did you study these examples?

19. In addition to the solved examples and exercises, there is some explanation given in every chapter for the new topic. Do you read it?

☐ A. Yes, from practically every chapter.

☐ B. Yes, in case of few chapters.

☐ C. No

20. In addition to your text-book, do you use any other books (excluding the guide books)?

☐ A. Yes.

☐ B. No

21. Do you use any guide books?

☐ A. Yes.

☐ B. No

If "yes", state below what kind of guide-books you use and whether you use guide-books for all the three subjects viz. Arithmetic, Algebra and Geometry.

22. Have you used question papers of the past examinations in Elementary Mathematics?

☐ A. Yes.

☐ B. No

If "yes", have you used solved question papers ?

☐ A. Yes.

☐ B. No

23. Mention below the way in which you prepared yourself in Elementary Mathematics for the last annual examination.

24. State the purpose for which you study the subject of Elementary Mathematics.

Appendix III

Points to be observed, in a Mathematics Class

1. Linking the present lesson with the previous one (s)
2. Explanation of the new concepts, principles, relationships and skills.
3. Ensuring learning of (2).
4. Selection of a problem (or an exercise).
   a) Source, e.g. the textbook, personal note-book, etc.
   b) Appropriateness, e.g. level quality, reality.
5. Presentation of the problem.
6. Analysis of the problem.
7. Ensuring students' understanding of the problem.
8. Solution of the problem.
9. Drilling typical difficulties of the problem.
10. Practice on similar problems.
11. Class work
    a) *Helping students individually.*
       i) removal of their difficulties
       ii) in their progress at their own rate.
    b) Helping them in small groups.
    c) Teaching the whole class.
12. a) How does he give home assignments?
       Does he give regular assignment sheets?
    b) Checking of home assignments.
13. Use of motivational devices.
14. Evaluation of pupil achievement during the period.
15. Use of the blackboard.
16. Use of mathematical links and symbols.
17. Use of aids, if needed.
18. Use of text-books.
19. Use of collateral text-books.

Five point scale for items observed in class

I. MOTIVATIONS

1. Is indifferent about the issue.
2. Always reprimands.
3. Encourages good students only.
4. Encourages the weak students only.
5. Reprimands and encourages when required.

II. LINKS THE PRESENT LESSON WITH THE PREVIOUS ONE

1. Just starts with the new lesson.
2. By asking what did we do last time and going ahead.
3. By asking students about their difficulties about the last lesson.
4. Links with the previous lessons by revising the connected topics through questioning.
5. Questions the students about all concepts which are likely to be utilised in the present lesson.

III. TEACHING NEW CONCEPTS, PRINCIPLES, RELATIONSHIP AND SKILLS

a) Introducing the new concept

- i) Simply defines the new concept.
- ii) Explains but explanation is not systematic.
- iii) Explains the concepts systematically.
- iv) Develops new concepts with student participation.
- v) Helps the students discover new concepts.

b) Ensuring learning of new concepts

- i) Does not bother about it.
- ii) Ensures it by asking the students if they have understood.
- iii) Ensures it through oral work.
- iv) Ensures it through written work.
- v) Ensures learning through oral and written work.

IV. PROBLEM-SOLVING

a) Selection of the problem

i) Does not make any selection but follows the order of the problems as given in the text-book.

ii) Selects only suitable problems given in the text-book.

iii) Selects suitable problems from different sources, but they are not real.

iv) Selects problems from different sources, which are suitable to their level of comprehension and are real.

v) Formulates suitable and real problems.

b) Presentation of the problem

i) Reads out the problem to the students.

ii) Asks students to read silently the problem given in the text-books.

iii) Asks a couple of students to read the problem aloud.

iv) He writes excepts from the statement of the problem on the black-board and reads it aloud simultaneously.

v) He writes the full statement on the blackboard and reads it aloud too.

c) Analysis of the problem

i) Does not analyse the problem at all.

ii) Does not systematically analyse the problem.

iii) Presents a systematic analysis of the problem.

iv) Presents systematic analysis of the problem at times putting suggestive questions to students.

v) Analyses the problem with full participation of the students.

d) Ensuring students understanding of the problem.

i) Does not bother about their understanding.

ii) Just asks them if they have understood.

iii) Questions some selected students.

iv) Questions some students and repeats the analysis if necessary.

v) Ensures understanding by almost all.

e) Solution of the problem.

i) Does not solve the problem at all.

ii) Presents the full solution of a new problem.

iii) Solves the problem without student participations.

iv) Solves the problem with participation of the students.

v) Discusses all possible methods of solving the problem.

f) Drill on typical difficulties of the problem

i) Does nothing about the issue.

ii) Just tells them about typical difficulties of the problem.

iii) Suggests some drill work.

iv) Gives them drill but not under personal supervision.

v) Always gives them drill and looks into individual needs.

g) Practice in similar problems.

i) Does not give any practice on similar problems.

ii) Gives general hints for solution of similar problems.

iii) Asks the students to solve one similar problem.

iv) Solves similar problems with student participation.

v) Selects and solves sufficient number of similar problems.

V. INDIVIDUAL AND GROUP WORK

a) Grouping the students.

i) Does not follow the group technique.

ii) Allows group work, grouping students according to their seating arrangements.

iii) Allows group work (grouping being at times homogenious and at other hetergenous).

iv) Allows group work (heterogenous ability grouping).

v) Allows group work (homogenous ability grouping).

b) Helping in individual difficulties.

i) Never attends to individual difficulties.

ii) Pays special attention to individual difficulties of good students only.

iii) Pays special attention to individual difficulties of weak students only.

iv) Attends to the individual difficulties of a few.

v) Attends to individual difficulties of almost all.

c) Supervision of student work in the class.

i) Does not supervise student work.

ii) Supervises on localised basis.

iii) Supervision is well distributed.

iv) Supervises almost all.

v) Supervises effectively.

VI HOME-WORK

1. Does not refer to home-work.
2. Signs the home-work in the class.
3. Assigns home-work.
4. Spends sometime on home-work before starting the days's lesson.
5. Checks the home-work of selected students in the class.

VII. USE OF TEACHING AIDS

a) Blackboard work.

i) Uses the blackboard rarely.

ii) Use of the blackboard inadequate and unsystematic.

iii) Use of the blackboard is adequate but unsystematic.

iv) Use of the blackboard is inadequate but systematic.

v) Use of the blackboard adequate and systematic.

1. Use of units of measurement in written work:
    a) Is not concerned about their use in class-work.
    b) Neither particular about using the units of measurement himself nor insists on students using them always.
    c) Not very particular in the use of units of measurements but insists on students using the same.
    d) Always uses the units of measurement himself but is not very particular about the students using them always.
    e) Always uses the units of measurement himself and insists on the students doing the same.
2. Use of mathematical links between different steps:
    a) Is not concerned about their use in the class-room?
    b) Neither particular about their use himself nor insists on their use by the students.
    c) Not very particular in their use but insists on their use by the students.
    d) Always uses these links himself but does not insist on their use by the students.
    e) Always uses these links himself and insists on their use by the students.

b) Use of other aids:

i) Does not use any aid.

ii) Uses unsuitable aids and that even ineffectively.

iii) Uses unsuitable aids but effectively.

iv) Uses suitable aids but ineffectively.

v) Uses suitable aids effectively.

c) The text-book.

Use of textbook.

i) Does not use the text-book at all.

ii) Uses the text-book only for home assignments.

iii) Uses the text-book only for practice problems and home assignments.

iv) Uses the text-book for the study of descriptive material solved examples and problems.

v) Supplements the text-book from his own notes.

Appendix IV

Points for teachers interview

Identifying date

State....................................

Town ....

School....................................

Class & Section........................

General date

Date....................Day..............

Subject & Topic........................

Medium of Instruction..................................

No. of Students: (a) Total...............................

(b) Present...............................

Time of the day..........................

Time-Table: (a) Total No. of periods in a week

....

(b) No. of periods for Elementary Mathematics in a week..................

(c) Duration of one period..................

(d) Total time for Elementary Mathematics per week...............................

(e) Who frames the time-table ?

....

(f) Distribution of periods in a class for a week.........................

(g) Allocation of work over sections and over classes;........................

....

(h) Whether teaching any other subject?

(i) Proportion of teaching load of Elementary Mathematics and Advanced Mathematics (Separately to the teaching load in other subjects.

Name of the teacher....................................

Qualifications of the teacher.........................

(a) General Education:

(b) Professional Education

(c) Experience of teaching Mathematics

(in years)

- i) Primary classes
- ii) Middle classes
- iii) High & Higher Secondary classes.
- iv) College classes.
- v) Training College Classes.

Text-books

(a) Who prescribes Textbooks ?

(b) Use of text-books in the class

- i) For solving problems
- ii) For reading solved examples (in the class)
- iii) For reading descriptions.

Whether any other material (Books, Question papers etc.) used for teaching ?

Home-work

(a) Whether assigned after every period.

(b) Source

(c) Whether same work given in all students.

(d) Whether checked the home-work in the class.

(e) Quality of checking:

- i) Corrections with instructions
- ii) Corrections only
- iii) Marking mistakes only
- iv) Remarks,

(f) Whether checked through group leaders.

Objectives of teaching Elementary Mathematics.

How are these objectives achieved in the classroom teaching situation?

Revision.

Evaluation of students' achievement during the period.

Examination Results and its use.

Given a free choice, would you like to teach?

Elementary Mathematics ?

Any suggestions to make.

Appendix V

Purposes of students' Group Interview

To know:

1. The present position of teaching of Elementary Mathematics in Higher Secondary Schools.
2. The position w.r.t. availability of individual help in the school
    a) inside class-room
    b) outside class-room
    in small groups a) within the class
    b) outside the class.
3. Regularity of checking of home-work assignments.
4. Work load of home-work.
5. Principal's checking of home-work note-books.
6. Checking of home-work with the help of group leaders.
7. Use of text-books.
    a) Exercises
    b) Other portions.
8. Revision.

Purposes of Teacher's Interview

1. To obtain certain physical information.
2. General techniques of teaching employed by him.
3. Home-work - procedure for checking.
4. Use of text-book
    other material
    reference
5. Planning of teaching.
6. Examination - use of their results.
7. Medium of instruction.
8. Teaching load and time allocation.
9. Qualification - general - professional.
10. Clarity of purpose of teaching mathematics.

Appendix VI

Points for study of note-books

A. **Class note-books:**

1. Systematic work done by a majority of the students.
2. Students copy whatever is said by the teacher.
3. Class-work shows no student interest in the subject.

B. **Home-work note-books**

1. Regularity of assignments by the teacher.
2. Regularity of work done by the students.
3. Tables of contents in the note-books.
4. Regularity of checking by the teacher.
5. Systematic work done by the students.
6. Quality of the checking done.
    - a) Corrections with suggestions
    - b) Corrections only
    - c) Marking the errors
    - d) Just signing
    - e) Remarks.
7. Appropriateness of assignments.
    - a) Level
    - b) Quality
    - c) Based on real situation

8) Assessment of work noted on the note-books.

9) Principal's checking of the note-books.
    - a) number of times
    - b) any remarks.

C. **Examination**

Answer scripts.

Appendix VII

Name of the School...

Date.....................................Place.......................

Examination Results

Year	Number of Students					
	On roll	Appeared	Passed	Who took Elem.Maths.	Who appeared with Elem.Maths.	Passed in Elem. Maths.
1964						

Total number of students in

IX Class: ....

X Class: ....

XI Class: ....

Total number of Students offering Elementary Mathematics in

IX Class: ....

X Class: ....

XI Class: ....